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LETTER OF TRANSMITTAL

To His Excellency, Hon. Simeon S. Willis, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under the act of Congress approved July 2, 1862," I herewith submit the fifty-seventh annual report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, Director.

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY
AGRICULTURAL EXPERIMENT STATION
For the Year 1944

The Kentucky Agricultural Experiment Station, through its researches of the past year, has made an important contribution to agricultural progress. The work has proceeded under difficulty, due to depleted forces, the almost impossible procurement of trained men and delays in obtaining equipment and necessary supplies. Much of the work, though temporary in nature, has contributed information needed during the war period. The difficult labor situation which prevailed necessitated the elimination of some of the field studies and changes or suspension of others. The inauguration of many new studies is planned as soon as trained men again become available. Brief reports follow of some of the important investigations of the year.

[See "*Index to Subject Headings*," pages 67 and 68.]

Barn hay drier.— In the second year of using the barn hay drier at the Station farm (by means of which unheated air is uniformly distributed under the hay and forced up through it), about 25 tons of alfalfa and 22 tons of soybean hay were cured over the two driers. The moisture content of the hay put into the barn varied from 30 to 48 percent, and part of both kinds was housed during rain. Part of the hay was housed 30 hours after it was cut, but most of it was placed on the driers not more than 6 hours after cutting.

From July 27 through September 30, the weather was very unfavorable for curing. There were 19 rainy days, with a total of 10.66 inches of rain. Also, during that period, there were many days and nights of high humidity. If the hay driers had not been used, much of the alfalfa and soybean hay would have been lost.

The alfalfa hay was cured on the drier without heating or molding, producing a very leafy, very green hay of high quality. The soybean hay in the bottom of the mow when examined November 28 was in excellent condition, being leafy and of a good color. In the upper part at the center of the barn, beneath the hay track where the men worked, the hay that had been wet by rain and compacted too much had a slight but not harmful amount of mold on some of the leaves. Some heating occurred here, making it necessary to run the fan longer to cool the hay and complete the curing.

Eighty-three kilowatt-hours of electricity were required to cure a ton of soybean hay. In 1943, 40 kilowatt-hours were required to cure a ton of alfalfa hay, but this year owing to the damp weather and the frequency with which small amounts of hay were placed on the drier, 174 kilowatt-hours were used per ton of alfalfa hay cured.

Work simplification.—Study of the equipment used in tobacco production resulted in the design and construction of several new devices. Those with widest application are (1) a "one-man plant-bed board" for use in pulling plants and weeding, which one man can move forward without unnecessary trips across the board to move the far end; (2) a hook-type topping and suckering knife which makes the job easier and faster, especially when inexperienced workers or children are topping and suckering; (3) a self-releasing hook for lowering tobacco from the top of a barn, enabling one man to do the work of two. By using the one-man plant-bed board and placing the plants directly in baskets, two men are able to do the work of three working in the usual way.

Some devices already in use by some farmers, which proved to be better than the usual equipment are (1) an improved tobacco cutting and splitting knife which is less tiring and requires less skill in use; (2) a long water hose attached to a large tank on a truck, which greatly reduces the time in filling tobacco-setter barrels and avoids the labor of pumping.

Detailed studies of actual farm workers this year confirm the finding in 1943, that experienced, skillful workers who have the highest rate of accomplishment generally follow the same methods. The differences in methods and equipment used account for most of the great differences in the amount of work done by different workers.

Forestry in the Eastern Highlands.—Inventory of the timber on 74 sample ownerships was finished this year, data on timber growth were compiled, and tables showing the yield (allowable cut) of timber on each type of land and in each forest type were prepared. A management plan was worked up for every forest compartment in each ownership. Outlines were made for drawing up silvicultural recommendations for each forest type. A small cooperative organization was formed during the year to protect woods from fire, which is one of the chief forest problems of the area. This cooperative had 18 members at the close of the year—about half of the forest owners in one community along the South Fork of Quicksand creek. Through vigorous prevention and suppression efforts, cooperating owners held fires down to less than 1 percent of their woodlands, while in adjacent forests outside the cooperative, 3½ percent burned over during the

year. In the marketing aspect of the study, interviews were held with production and marketing agencies in the market centers.

Trend in price of farm land.—An analysis covering the years 1912 to 1944 showed that the price of farm land in Kentucky in 1944 reached a point $\frac{4}{5}$ as high as in the boom year 1920. During the past 11 years Kentucky land prices have increased an average of 10 percent a year, and during the past 3 years an average of 15 percent a year. Farmers in the state were warned of the dangers of buying land at an inflated price.

Transportation of milk to market.—Practically all the fresh milk consumed in the larger cities of Kentucky was handled in 1943 by 71 distributors who collect it on commercial milk routes. Of these distributors, 65 received nearly 204 million pounds of milk on 220 collection routes. The other 6 got their supply on routes collecting milk primarily for manufacturing plants. The 220 routes averaged 62.3 miles each. In the Louisville area, where it was necessary to reach out farther for the supply, the routes averaged 76.5 miles; those for smaller cities averaged only 40 miles. To cover these routes during the year, trucks traveled nearly 5 million miles, ranging from 3,538 to 84,424 per truck, and averaging 22,586 miles. On these 220 routes milk was collected from 4,562 farmers—an average of 21 per route. Thus, it required 3 miles of truck travel per day per patron, or 1,086 miles per year per patron, to collect the milk. During the low season of production, loads ranged from 14 10-gallon cans to 134 10-gallon cans, and averaged 56 cans. During the flush season the loads were 10 to 100 percent larger. The trucks used were large enough to handle the peak loads during the flush season; they therefore had much unused capacity during most of the year.

In 1943, there were 315 routes, averaging 50.7 miles per route, collecting milk for delivery to the 21 manufacturing plants in Kentucky. During 1943, trucks covered these routes an average of 300 days (every-other-day collection during winter), traveled 5 million miles, and averaged 15,991 miles per route. Milk was collected from 11,790 farms during April, 1943, or an average of 37.4 patrons per route. The trucks traveled 1.35 miles per patron per trip during April, and hauled an average of 49 pounds of milk per patron per trip.

An analysis of routes indicated that much mileage could be saved, and considerable improvement in the efficiency of the collection systems could be made by combining small, inefficient routes with other routes; by reducing back-tracking to a minimum; by eliminating the practice of retracing the route to deliver empty cans; by combining loads from adjoining routes at some country point for delivery into

the plants; by combining adjoining routes during the winter, and, in collecting milk for manufacturing, by requiring roadside pickup. In making recommendations for any given situation such variations as available outlets, distance from market, availability of transportation facilities, condition of highways and roads, and other factors had to be taken into consideration.

Seasonal pattern of tobacco prices.— Under the hogshead system of tobacco marketing which formerly prevailed in Kentucky the seasonal variation in prices was small, though prices moved upward by infrequent stairsteps throughout the season. This pattern of prices continued practically without change until hogshead marketing was replaced by looseleaf marketing. It was due in part to the cumulative influence of marketing costs, particularly storage costs; the distance between areas of production and the market, with accompanying difficulties of transportation; and the method of reporting prices in ranges rather than as averages. The highly stable character of the price patterns was the basis for much farmer dissatisfaction with the hogshead system of marketing.

Under the looseleaf system the seasonal variation in tobacco prices, until the past few years, was large and tended to become greater from year to year. Prices moved downward with frequent sawtooth-like adjustments throughout most of the sale season. These characteristics arose, in part, out of the fact that the looseleaf system moved the center of selling nearer to the center of production, and the influence of marketing services and costs of middlemen were greatly reduced or eliminated by manufacturers adopting the practice of purchasing the greater part of their needs directly from producers. Seasonal decline in the price arose in part from the decline in quality of tobacco offered, and in part from decline in demand caused by some buyers completing their purchases and other buyers becoming sellers to dispose of their surpluses and undesirable grades before the close of the sale season. Increase in amount of seasonal variation and shortening of the sale season resulted from the greater capacity of the markets to sell and the efforts of growers to adjust production and sale practices in order to dispose of their tobacco ahead of the expected seasonal decline in prices.

During the past 3 or 4 years a reversal has occurred in the seasonal pattern of tobacco prices. The sale season has lengthened again, seasonal variation in prices has narrowed, and the downward seasonal trend in price has become less pronounced. The increase in length of sale season is due mainly to labor shortages, both in the preparation for market and in the warehousing and redrying of tobacco. The

greater seasonal stability of prices arises in part from the minimum price policies established by farmer cooperatives and maximum prices established by Government wartime controls; and, in part, from the relatively stronger demand for the lower grades of tobacco, with consequent reduction in reselling. More adequate market information based on grade and quality may also have influenced seasonal price movements.

Commercial feed purchased in Kentucky.—According to license tags sold in the 5 years 1939 to 1943, Kentucky farmers bought between 10,000 and 20,000 carloads (60,000 pounds each) of commercial feed, besides an unknown though substantial amount of feed grain and hay. The commercial feed bought was about 5 percent of all feed used (hay, forage, and grain combined) but amounted to roughly 15 to 20 percent of the concentrates fed. Farm expenditures for commercial feed ranged between 10.5 and 37 million dollars annually, and amounted to 16 to 20 percent of the cash income received from sales of livestock products in these years. During this period Kentucky maintained between 2 and 2.5 million "animal units" of livestock and raised more livestock than could be fed from the feed grown in the state.

Well-established feed manufacturers and distributors in 18 states supplied Kentucky with feed ingredients and feed mixtures. License tags issued in 1943 show that 45 percent of the gross tonnage of commercial feed sold in Kentucky was tagged by manufacturers giving a Kentucky address. Ohio firms handled 19 percent, Illinois 12, Indiana 9, and Missouri 5 percent. The remainder was tagged by firms in Minnesota, Tennessee, Pennsylvania, West Virginia, Kansas, Nebraska, Iowa, New York, Alabama, Georgia, Oklahoma, Michigan, and Arkansas. Significantly, firms located in Kentucky and four of the adjoining states tagged 90 percent of the gross tonnage of commercial feed sold.

The bulk of commercial feed is handled by a relatively small number of manufacturers. In 1943, for example, roughly 70 percent of the commercial feed was tagged by 10 percent of all the distributors buying tags. More than 90 percent was tagged by less than 30 percent of all tag buyers. Among the largest distributors are nationally known milling and grain processors, or their subsidiaries, and a number of large, independently owned feed manufacturing establishments. Many of these firms push the sale of branded and widely advertised "special purpose" feed mixtures through well organized national or regional sales departments. These manufacturers choose favorable locations

which are also the points chosen by grain dealers, brokers, and commission agents serving smaller feed dealers. As a result, more than 70 percent of all feed was moved to Kentucky through 10 major market centers, and 80 percent was processed or reshipped from 20 market centers. Manufacturers in the vicinity of Chicago, St. Louis, Toledo, Cincinnati, Louisville, and Lexington are prominent in the distribution of grains, by-product ingredients, and feed mixtures to Kentucky markets. Converging water, rail, and highway lines, and the presence of marketing agencies and grain storage and warehouse facilities, give these cities certain strategic advantages for selling feed in Kentucky.

In all the major marketing centers near Kentucky's borders, dealers cater to trucks hauling for small stores, merchants and others, and use a rather flexible system of pricing based on the volume of business and, to some extent, the kind of buyer. A variety of feeds, especially commercial feeds, is shipped or trucked continuously to nearly every community serving farmers. Accordingly, farmers have been encouraged to use it whenever their own feed supplies were exhausted or whenever they felt it paid them to buy feed supplements.

Labor requirements on mountain farms.—Detailed farm management studies on 64 representative mountain farms in Breathitt county in 1944 showed that the rough steep land, small fields, and the 1-mule or hoe type of equipment greatly increased the labor requirements for crops, as compared with costs in most other farming regions. An average of 87 hours of labor was used per acre of corn raised on bottomland in 1944 and an average of 114 hours on hillside land. For both types of land the two principal peak labor periods for corn were at time of cultivating and at harvest. Sixty-seven percent of the labor for crop production on the 64 farms was used for corn. Soybean hay required an average of 56 hours per acre if harvested with a scythe, or 32 hours if harvested with a horse-drawn mower. Most of the fields used for soybean hay were in the range from $\frac{1}{2}$ to 3 acres. Garden truck produced largely for home use averaged about 1 acre per farm; the labor required, including harvesting, averaged 340 hours per acre, mostly for hoeing. Twenty-eight percent of the labor on crops was used to produce garden truck. Burley tobacco, grown on relatively few farms and in small patches of $\frac{1}{2}$ to 1 acre each, required an average of 470 hours per acre. There were 3 labor peaks in tobacco production—in May (preparing land and setting), in August (cutting and housing), and in November (stripping and preparing for market).

The small number of livestock per farm, poor accessibility of pas-

ture and water, and the kind of buildings and equipment used increased the labor necessary for caring for livestock in Breathitt county, as compared with other regions. Care of workstock, usually one mule, required an average of 150 hours of man labor per animal, and, as compared with the Central Bluegrass area, required more than 3 times as much labor per animal per year. Forty-four percent of the labor for care of livestock was for milk cows. Other cattle, principally stocker calves and dairy heifers, required 44 hours per head per year. Care of milk cows required 60 percent more labor per cow, and of chickens 25 percent more per hen per year, while stock calves and dairy heifers required 4 times as much labor per head as in the Central Bluegrass area.

Soil fertility studies at the outlying experiment fields.—At all outlying soil experiment fields marked response has been obtained to a soil-management system involving applications of limestone and phosphate, use of a good rotation including legumes, and applying of manure in amount equal to the weight of crops removed, except wheat grain. This system of soil management has provided the nitrogen and potassium for good yields of general farm crops. During recent years, however, increased response to potash fertilization is being obtained.

In 1944, average acre-yields of plots receiving only manure were 22.2 bushels of corn, 6.1 bushels of wheat, and 615 pounds of mixed clover hay. Increases in yields for superphosphate in addition to manure were 17.4 bushels, 9.7 bushels, and 760 pounds, respectively, of these crops. Limestone with the superphosphate gave additional increases of 0.3 bushels of corn, 5.1 bushels of wheat, and 438 pounds of hay, while adding muriate of potash to the fertilization gave further increases of 3.8 bushels, 4.6 bushels, and 292 pounds, respectively, of these crops.

Field tests of fused phosphates.—Fused phosphate prepared by the Tennessee Valley Authority for release in 1943 was tested in field plots. Ground fused phosphate (40-mesh and 80-mesh) and quenched but unground phosphate containing 0.3 percent fluorine and passing a 6-mesh screen, were compared with triple superphosphate on limed and unlimed silt loam soils at three locations. Corn was harvested from the plots in 1943 and wheat in 1944. Phosphates were applied at rates equivalent to 40 pounds total P_2O_5 for corn and 20 pounds for wheat. Because of adverse seasonal conditions, rather low yields of both corn and wheat were obtained. Average relative yields for corn and wheat on limed and unlimed plots were: no phosphate,

70; triple superphosphate, 100; fused phosphate, 6-mesh, 99; 40-mesh, 103; and 80-mesh, 98.

Residual effect of potash in manure.—From 1920 through 1938, manure was applied at different rates on different plots before each corn crop in a 3-year manure-rotation experiment of corn, wheat, and clover hay. No chemical fertilizers were used during this period. In 1939 the manure applications were discontinued, the plots were divided, and 200 pounds per acre of muriate of potash applied to half of each plot before corn. The 1944 corn crop is the second in the series after the change was made. On a plot where no manure had been applied, the yield of corn was 25 bushels on the half not receiving potash, and 34 bushels on the potash-treated half. On a plot receiving manure at the rate of 4 tons per acre in 1920-1938, yields also were 25 bushels on the untreated half and 34 bushels on the treated half; but on a plot receiving manure at the rate of 10 tons per acre in 1920-1938, yield was 31 bushels on the untreated half and no better where potash was applied. It appears that there is no longer any residual effect from the potash in manure applied at the 4-ton rate but that the 10-ton rate supplied so much potash that further additions of potassium fertilizer are not yet needed. All corn yields were low because of drouth in June and July.

Lasting effect of phosphates.—In experiments begun in 1934 on phosphate-deficient soils, 18 percent superphosphate, triple superphosphate, dicalcium phosphate, and tricalcium phosphate were applied to separate plots in a 3-year rotation of corn, wheat, and mixed clover and lespedeza for hay. The quantities were such as to add 15 pounds of P_2O_5 for each corn crop and 40 pounds for each wheat crop, or a total of 165 pounds from 1934 to 1941, inclusive. No phosphate was applied after 1941. Increase in yield of wheat in 1937, 1938, 1940, and 1941 was about the same for the first 3 phosphates mentioned, and averaged 340 percent of the yield on the no-phosphate plots. Increase from tricalcium phosphate, however, averaged 292 percent. For 1943 and 1944, when no phosphate was applied, the corresponding averages on the plots where the different phosphates had formerly been applied were 136 and 137 percent of the yield on the no-phosphate plots—a considerable decrease from the yields obtained when phosphate was applied, but nevertheless showing appreciable benefit from the phosphate remaining in the soil.

Phosphate fertilizer on pastureland.—Untreated plots on a permanent pasture at the Western Kentucky Experiment Substation produced an average of 891 pounds of dry matter per acre. Plots that

had been treated in alternate years, with 32 pounds of P_2O_5 per acre in 20-percent superphosphate, triple superphosphate, dicalcium phosphate, and tricalcium phosphate, produced average increases in yield over the untreated plots of 992, 742, 882, and 787 pounds of dry matter per acre, respectively.

On 4 plots on which 125 pounds per acre of available P_2O_5 in superphosphate, triple superphosphate, metaphosphate, and fused rock phosphate was worked deep into the soil prior to seeding permanent pasture, the yield of dry matter was 2,324, 2,033, 1,902, and 1,386 pounds per acre, respectively, in a test near Greenville. When equal amounts of each of these same phosphates were used in top-dressing a different set of plots on the same pasture during a 5-year period, the dry matter was 1,112, 1,345, 1,495, and 1,260 pounds, respectively, in the fifth year. Working the phosphate into the soil beforehand was thus superior to top-dressing near Greenville. In similar tests near Mayfield, the two methods were about equally effective in promoting herbage production.

Nitrogen top-dressings on bluegrass sod.—Top-dressings of ammonium nitrate (32.5 percent nitrogen) were made late in February on the Station Farm on a good bluegrass sod and the grass was harvested for ensiling May 12. Yields of oven-dry matter per acre were: untreated, 842 pounds; 100 pounds ammonium nitrate, 1,322 pounds; 200 pounds ammonium nitrate 2,007 pounds. Applications the first of April were almost as effective. Carotene content of the herbage was improved by the nitrogen treatments, that of the untreated plot being 0.26 milligrams per gram of dry matter, and that of the 100 and 200 pound rates being 0.32 and 0.34 milligrams respectively.

Nitrogen top-dressing on wheat.—In 7 tests on wheat following corn on land which yielded an average of 18.4 bushels of wheat per acre without nitrogen fertilizer, the largest increase in yield (12.7 bushels) was from 60 pounds of nitrogen as ammonium nitrate per acre, 20 pounds of which was applied in the fall and 40 in the spring. However, this was practically the same increase as was obtained from 20 pounds in the fall and 20 in the spring (12.3 bushels) or from 40 pounds applied in the spring (12.4 bushels). Fall application was at or about the time of sowing; spring application was in March or early April. Fall application of 20 pounds of nitrogen increased yield 5.2 bushels; and of 40 pounds, 10.1 bushels; whereas 20 pounds in the spring increased yield 8.5 bushels. Largest increase per pound of nitrogen was from 20 pounds applied in the spring (0.425 bushels).

Nitrogen top-dressing on grass for hay.—As the average of 6 tests, the largest increase (918 pounds of hay calculated water-free) was from 20 pounds of nitrogen applied in the fall and 40 in the spring, but the largest increase per pound of nitrogen (22.3 pounds of hay) was from 20 pounds applied in the spring.

In similar tests at the Lexington, Berea, Greenville, and Mayfield experiment fields average acre-increases in yields of hay (water-free basis), of all fields and all dates of application were:

Nitrogen	Hay (water-free)
20 pounds	441 pounds
40 pounds	1,046 pounds
60 pounds	1,361 pounds

Average acre-increases, all three rates of application, at different dates, were:

	Hay (water-free)
September	621 pounds
November	785 pounds
February	1,027 pounds
March	1,323 pounds
April	917 pounds

The average yield per pound of nitrogen applied was slightly the largest for the 40-pound rate. As to date of application, the largest return per pound of nitrogen resulted from 20 pounds applied in March and the lowest from 20 pounds applied in September. Fall application, though it increased growth of herbage for pasture, was less effective than spring application for increasing yield of hay.

Experiments with burley tobacco on Maury silt loam.—Burley tobacco has been grown continuously in an area on the Station farm at Lexington since 1906. In 1941 plots were laid out in this area for certain manure and fertilizer treatments which have been made each year since. In 1943 where 20 tons of manure per acre was applied, the yield of leaf was 2,150 pounds. Where 150 pounds of nitrogen as urea and 200 pounds of sulfate of potash were applied, the yield was 2,050 pounds, and where no manure or fertilizer was applied, the yield was 1,200 pounds. The tobacco grown on manured land was valued at 52 cents a pound; that on land fertilized with urea and sulfate, at 50 cents; and that on land not fertilized, at 42 cents.

In 1943, as an average of 5 carriers, the application of 80 pounds of nitrogen per acre increased yield of burley grown in a 2-year rotation, from about 1,600 to 1,700 pounds per acre. This increase, while profitable, is much smaller than that obtained in other tests on this farm, where the yield of the tobacco receiving no nitrogen was considerably smaller. The estimated value of both lots of tobacco was 51 cents a pound.

In rotation experiments comparing different combinations of common grasses and legumes for sod crops preceding burley, yield and quality of the crop in 1943, as in previous years, was not greatly affected by the sod crop used. Yields in general were between 1,400 and 1,500 pounds an acre. In these experiments the sod crops were clipped from time to time and left on the ground. Potash was applied but no nitrogen.

Nutrients lost from tobacco stalks by leaching.— Tobacco stalks at stripping time contain substantial amounts of nitrogen and potassium, some phosphorus, and when well preserved are valuable for fertilizer. Often, however, these stalks are piled where they are subject to leaching from rain. At the end of a 100-day period, stalks piled under the eaves of a shed had lost 40 percent in weight, 61 percent of their nitrogen content, and 83 percent of their potassium content.

Tobacco stalks often are spread on lawns or pastures in winter to increase the growth of grass. Because the nutrients leach from them readily they are generally effective for this purpose. One lot of stalks, left on the lawn for 50 days in January and February, and leached by 3.87 inches of rain, mostly in light showers, lost 40 percent of weight, 63 percent of its nitrogen content, 50 percent of its phosphorus, and 80 percent of its potassium. Another lot leached for 100 days by 13.35 inches of rainfall lost 50 percent in weight, and 69, 50, and 94 percent, respectively, of its nitrogen, phosphorus, and potassium. At the end of this period the stalks were still hard and tough when dry.

Effect of fertilizers on yield and composition of clover.— Two clover crops were grown in jars in the greenhouse on soil from the check plots of the Campbellsville experiment field, treated with different amounts of lime (precipitated calcium carbonate) and of phosphate and potassium fertilizers. After the treatment and before the clover was grown, two crops (wheat and buckwheat) were grown in the jars. All crops were analyzed for calcium, magnesium, potassium, phosphorus, iron, and manganese. The treatment had very similar effects on both yield and composition of all crops; there were, however, some important differences. As compared with the first crop (wheat plants) the yield of clover was lower on the unlimed and much higher on the limed soil. Both superphosphate and rock phosphate caused increase in yield in proportion to the amount used. Where rock phosphate was used, liming had a pronounced depressing effect on yield of wheat and buckwheat but not as pronounced an effect on yield of clover. As evidenced both by yield and composition, ap-

plication of calcium carbonate to this soil increased the availability of phosphorus to all four crops. Potassium fertilizer increased yield of clover by 10 to 15 percent but had no effect on yield of wheat or buckwheat.

The phosphorus content of clover was increased by phosphorus fertilization and by liming but was not so high as in the wheat or buckwheat plants. In only one case did the phosphorus content of clover decrease with increased liming. That was where a high rate of rock phosphate was applied. Liming increased the calcium content of clover in all cases but the increase was greater where superphosphate was used than where rock phosphate was used. The percentages of magnesium, iron, and manganese in the clover generally were inversely proportional to the quantity of calcium carbonate applied. Manganese was 2 to 3 times higher in the clover from unlimed soil than in that from limed soil. It was considerably higher in all crops where the potassium level in the soil was low. Potassium fertilization increased the potassium content of clover in all cases. Where yields were high the potassium content of crops grown with high phosphorus fertilization was lower than when yields were lower, regardless of potassium fertilization.

Yields of hybrid and of open-pollinated corn.—In addition to tests at the Station farm, uniform tests for comparing yields of 22 hybrids and the 2 open-pollinated varieties of corn now most widely grown in Kentucky were made in Webster, Caldwell, Warren, Madison, and Fayette counties. The average yield of the twenty-four varieties in the five locations was 41.6 bushels per acre. Yields were very low in Madison county, and much lower in Fayette and Warren counties than they would be in a normal year. The yellow hybrids grown commercially in Kentucky ranked 6th (US 13), 7th (Ky 103), and 13th (Ky 102). Reid's Yellow Dent, the open-pollinated yellow variety, ranked 23rd. The three yellow hybrids averaged 11.3 bushels more per acre than Reid's Yellow Dent, or 34.3 percent. The two white hybrids grown commercially ranked 8th (Ky 72B), and 19th (Ky 203); while the open-pollinated Boone County White ranked 24th. The two white hybrids yielded 14.4 bushels more per acre than Boone County White, or 52.4 percent. The yellow hybrids in all tests averaged 44.5 bushels per acre, and the white hybrids 40.8 bushels per acre.

The more promising Kentucky experimental yellow hybrids were Ky 122, Ky 123, Ky 120, and Ky 121, which ranked 1st, 4th, 5th, and 10th, respectively. Ky 122 and Ky 123 also ranked high in yield in 1943, but both these hybrids have weak roots and stalks. Ohio 3089 ranked high in the individual county tests and ranked 2nd as an average of the

tests in the five counties. Kansas 2234 was the highest yielding white hybrid, while Ky 223 was the most promising Kentucky experimental white hybrid. In general, the hybrids ranked about the same in all the individual tests. Reid's Yellow Dent ranked no higher than 18th in any one test, and Boone County White ranked last in all the tests.

Early maturing hybrid corn in corn-borer control.— One means of combatting the European corn borer may be to use early maturing hybrids that can safely be planted considerably later than the normal planting period. In order to determine whether early maturing hybrids would yield well in Kentucky, four early maturing hybrids from Wisconsin and US 13 were planted May 26 for comparison with US 13, Ky 102, and Ky 103 planted at normal planting time, May 2. Because of extremely hot, dry weather when the early maturing hybrids were pollinating they averaged only 12.3 bushels per acre—not a true indication of the normal performance of these hybrids. US 13 planted late escaped the hot, dry weather at pollinating and yielded 45.6 bushels per acre. The three hybrids planted at the normal time also encountered hot, dry weather when pollinating, and averaged 30.7 bushels per acre. The population of borers was too low to obtain any correlation between the percentage of infestation and date of planting.

Life history studies of the European corn borer.— Studies made in 1944 indicate that the corn borer *Pyrausta nubilalis* Herbst has 3 broods a year in Kentucky, the third brood being very small in number. First-brood worms injured leaves and stalks of early-planted field corn from the time it was 2 feet tall until it reached maximum height and began silking, by which time the larvae had completed their development. Second-brood worms began injuring corn when it was in the milk stage, feeding first on the leaves and then boring into the stalk, or sometimes injuring ears by feeding on the kernels or tunnelling through the ear shank and causing the ear to drop. Third-brood worms, few in number, appeared in September.

The European corn borer overwinters in the larval stage, usually within corn stubble. Overwintering larvae began pupating at Lexington May 10, and most of them had pupated by the end of the month. Moths emerged May 22 to June 8, and egg-laying began May 26. First-generation larvae, which were somewhat more abundant than in 1943, began hatching May 31 and some were full-grown by the end of June. Pupation began July 2 in early-planted field corn and 97 percent of the first-generation larvae had pupated by the end of July. Most of the larvae pupated in burrows within the lower 7 joints of the plants.

First-generation moths emerged July 10 to August 5, and egg-laying

was heavy during the last two weeks of July. Hot, dry weather was unfavorable for establishing of many second-brood larvae. Some of these were full-grown by the second week in August and slightly more than 4 percent of them pupated (beginning August 15) to give rise to a small third generation. Moths appeared from these pupae late in August and laid eggs during early September. Some third-brood worms were not yet fully grown in early October.

Effect of planting date on corn-borer infestation.—In 1944, field corn planted during or before the first 10 days in May frequently had much first-generation European corn borer, whereas corn planted after May 15 escaped attack by most of the first-generation worms. In one test Reid's Yellow Dent planted May 10 averaged 0.9 first-generation borers per stalk compared with none in adjacent rows planted May 19. Late planting therefore appears to be one means of combating corn-borer infestation.

Corn-borer infestation of hybrid and other corn.—Twenty-two hybrid and 2 open-pollinated field corns planted May 1-2 on the Station farm were compared as to infestation by first- and second-generation European corn borers. Samples of 10 stalks each, in each of 2 replications, were dissected in late June and early July. The number of first-generation borers ranged from 0 to 6 per stalk, the average number in the different varieties ranging from 0.1 to 1.05 borers per stalk. In general, more borers were found in the early-maturing or the taller-growing corn. In dissections in September and October the number of second-generation borers in the various corns averaged .2 to 2.15 borers per stalk, and there was no apparent correlation between number of borers and time of maturity of the corn. The total number of borers averaged .35 to 2.65 per stalk for the 24 kinds of corn, most of the strains averaging 1 to 1.5 per stalk.

Corn-borer infestation of new, insect-resistant hybrid corn.—Twenty-three insect-resistant, single- and double-cross hybrids planted May 4-5 on the Station farm were compared as to infestation by first- and second-generation European corn borers. Very few first-generation borers were found except in two of the earliest-maturing hybrids (50 percent silking dates July 9 and 10). Three hybrids having low infestation by first-generation borers and high infestation by second-generation borers were later-maturing types (50 percent silking dates July 16, 19, and 21). The earliest-maturing hybrid (50 percent silking date July 9) had high infestations of both first-brood and second-brood borers. Six of the hybrids, ranging from early to late sorts, had few borers of either generation.

Parasites of the European corn borer.—Adults of 3 species of corn-borer parasites were furnished by the Federal Bureau of Entomology and Plant Quarantine for release in Kentucky. June 20, 1944, 500 adults of *Lydella gusescens* and 4,200 adults of *Macrocentrus gifuensis* were released. On July 1, 500 adults of *Inareolata punctoria* and 6,300 adults of *Macrocentrus gifuensis* were released.

Adults of the exotic, polyembryonic parasite *Macrocentrus gifuensis* were recovered late in the season from 2 parasitized corn borers, indicating good chances for the parasite's establishment. Also found were several puparia of a dipterous parasite of corn borer larvae.

Corn-borer survey.—With the cooperation of the Federal Bureau of Entomology and Plant Quarantine, surveys of corn borer infestation were made in late August and early September in 17 Kentucky counties scattered over the state, where corn borers had been found previously. In addition, scouting to determine the spread of corn borer this year was carried out in a number of counties where corn borer had not been found before. Five counties, Lincoln, Butler, Logan, McLean, and Muhlenberg, were found infested for the first time. The spread of corn borer was much less in 1944 than in 1943.

Corn improvement.—In an effort to obtain hybrids with better root and stalk strength and resistance to the major disease and insect pests, 10 white and 17 yellow inbreds were tested, at two locations in Kentucky, in all possible single-cross combinations, to determine the best lines suited to Kentucky conditions. Several of the more recently developed Kentucky lines also were tested in combination with older established lines. Several white and several yellow inbreds gave evidence of carrying considerable resistance to stalk breakage, leaf blights, and insect troubles in addition to factors for high yielding ability. These inbreds are being incorporated into hybrid combinations for more advanced testing.

In an effort to find better breeding material than is now available, approximately 40 locally grown open-pollinated varieties were collected in 1943 for the production of inbreds. These were collected from areas where they had survived all the adverse weather conditions for as many as 50 years. Of this number, 6 white and 6 yellow varieties were grown in 1944. Out of approximately 2,000 plants self-pollinated, 100 white and 125 yellow selections appearing to have most of the desired qualities were harvested. New inbred lines also are being developed through hybridization and selection of established inbred lines with desirable qualities.

Plowing versus disking for corn.—In a field having a good growth of wheat 15 inches high when the land was prepared the middle of May, two plots were plowed 7 inches deep and fitted for corn in the conventional manner and two other plots alongside were not plowed but were thoroughly disked 3 inches deep. The corn grew considerably more slowly on the disked than on the plowed plots during June and July when the weather was dry, but with good rains in the latter half of the summer, the plants on the disked plots made good growth, and difference in yield between the disked and plowed plots was smaller than expected from midsummer observations. Average acre-yields were: disked plots, 43 bushels; plowed plots, 50 bushels.

Hybrid popcorn.—Five Purdue hybrids, in commercial use in Indiana, and 2 Kentucky experimental hybrids were grown on the Lexington farm, in comparison with the most commonly grown South American open-pollinated variety. All yields were affected by drouth. The highest-yielding hybrid, Purdue 3, yielded at the rate of 1,846 pounds of ear corn per acre, 90 percent more than the open-pollinated variety which yielded 970 pounds. The average yield of the 5 Purdue hybrids was 47.7 percent above that of the open-pollinated strain. Ky 1 hybrid, a white corn, yielded 54 percent more than the open-pollinated strain. In a similar test on bottomland at Owensboro, yields of ear corn per acre were at the rates of 3,062 pounds for Purdue 32, 2,953 for Purdue 23, 2,638 for Ky 1, 2,215 for Ky 2, and 2,989 and 2,759 for South American open-pollinated varieties.

Hardiness of winter oats.—The winter of 1943-44 was rather mild, the lowest temperature being +5 degrees F, but fall-sown oats made little fall growth because of drouth in September and October, and survived the winter poorly. Winter Fulghum, Fulwin, Forkedeer, and Tennex were hardiest. Fulwin survived, on the average, 54 percent, and Winter Fulghum 49 percent, followed by Forkedeer and Tennex. Woodward Strain, a common winter oats, survived nearly as well as Winter Fulghum. Wintok, a common winter oats selected and grown in Oklahoma, and Bicknell, another common winter oats, survived 30 and 25 percent, respectively. All other varieties, including Winter Turf, were killed nearly completely. Even Fulwin, the hardiest variety, is not dependable in Kentucky, and efforts are being made to obtain hardier selections through hybridization.

New varieties of spring oats.—Five varieties of spring-sown oats were grown in large plots, and 8 in rod-row tests. Planted late, the oats made rather poor growth, and averaged 39.3 bushels per acre in the plot tests. The old variety, Fulton, and the new variety, Ventura,

both developed at the Kansas Station, outyielded Columbia by 9 bushels per acre. Neosho, also released by the Kansas Station, yielded 7 bushels more per acre than Columbia. In the rod-row tests two new varieties from Kansas, Osage and CI 4140, yielded significantly more than Columbia, produced heavier grain, and are resistant to rust and smut. In another yield test involving 34 varieties, 7 new selections from crosses with the rust- and smut-resistant Victoria-Richland hybrid yielded better than Columbia, and several of the newer varieties grown in the corn-belt states also showed much promise for Kentucky.

Winter barley.— In plot and rod-row tests of winter barley, Ky 1 continued to be the highest-yielding of the commonly grown winter-hardy varieties. A smooth-awned line from the Purdue Station produced the highest yield (56 bushels per acre) in plot tests but was below Ky 1 in the rod-row tests. Purdue 21 yielded nearly as much as Ky 1. Reno and Admire, although winter-hardy, were lower yielding. Two new selections from West Virginia showed some promise in yield but were less hardy than Ky 1, and one, being hooded, shattered badly. Ky 1 and Purdue smooth-awn produced the best grain.

Winter barley made very poor growth during the fall of 1943 and, in general, survived rather poorly. In the winter-hardiness test, 48 varieties were grown, among which were most of the recent introductions by experiment stations and the U. S. Department of Agriculture, as well as the older, well-established varieties. Of the latter, Ky 1, Tennessee Winter, and Purdue smooth-awn survived 70 percent, while Purdue 21, Reno, and Missouri Early Beardless survived about 60 percent. New introductions surviving better than 60 percent were Kirwin, Poland, Ohio 1, Iredell, and two selections from the Tennessee station. Ten new selections developed at the Ohio Station from common winter barley survived better than 60 percent, 3 having higher survival percentages than Ky 1, but being essentially similar to it in all other respects. Wong and Marnobarb are not dependable in Kentucky, but are stiff-strawed and resistant to several diseases and are therefore being used extensively in the breeding program. Of 45 foreign introductions by the U. S. Department of Agriculture 9 were comparable to Ky 1 in survival percentage. Several of these are resistant to mildew and loose smut and should be valuable breeding material.

Wheat varieties.— In plot and rod-row tests of 6 varieties of winter wheat commonly grown in Kentucky, Thorne outyielded the other varieties by 4.7 bushels per acre. Ky R47 (Currell's), Ky NS 6 (Posey's Bluestem), Trumbull, and Fairfield (a new variety distributed and grown extensively in Indiana) all yielded at the rate of 38 bushels

per acre. Though leaf and stem rust were not generally severe in 1944, all the varieties except Fairfield were badly infected. Fairfield, however, is not considered resistant to rust. R47 and Ky NS 6 produced the best grain.

Several new hybrids tested in observational rows showed promise. Some, from crosses between hard and soft wheats, carry the rust resistance of the hard wheat while remaining soft.

Improvement of Kentucky bluegrass.—Some 1,500 selections of Kentucky bluegrass were inoculated in the greenhouse with various of the diseases listed in last year's report as being serious on this grass in Kentucky. Somewhat more than one-third of the selections appeared to be relatively resistant to one or more diseases. These selections were transplanted to a spaced plant nursery for further testing.

Meadow fescue.—Ky 31 meadow fescue and other grasses were harvested twice during the season, from plots sown in the fall of 1942. Ky 31 produced at the rate of 1,020 pounds of hay per acre. Southern smooth brome grass produced at the rate of 990 pounds; Kentucky bluegrass, 1,140 pounds, redtop, 630 pounds; and orchard grass, 905 pounds. Timothy produced 905 pounds from the first cutting, but made no recovery and died before fall. Total rainfall in the growing season was about 1.5 inches less than normal; temperatures were much above normal during the first half of the season and slightly below normal during the remainder.

Yields of Ky 31 meadow fescue in these tests were about the same as in previous tests. On good soil this grass produces about the same amount of forage during the summer as other adapted grasses, but under various handicaps of soil and weather it appears to advantage. It makes good growth on wet soil, is more productive of forage than other palatable grasses on poor soil, and is resistant to drouth and heat. It is also resistant to cold, and makes some growth during winter. Seed yields range from 100 to 300 pounds per acre and the seed is easily harvested. Being a vigorous-growing bunch grass, it grows well with legumes. It is rapidly increasing in acreage in Kentucky, and it seems certain to become one of the most important grasses of Kentucky, adding greatly to the pasture resources of the state.

Control of green June beetle and *Phyllophaga* larvae in bluegrass sod.—Lead arsenate was applied on bluegrass sod in March, 1943, in amounts of $\frac{1}{2}$, 1, and 2 pounds to 100 square feet to determine its effectiveness during one or more seasons. Each treatment was replicated 6 times on plots of 200 square feet and there were 6 untreated plots. In 1944, the $\frac{1}{2}$ pound application gave 77 percent

control of green June beetle larvae and 25 percent control of *Phyllophaga* larvae; the 1-pound application 91 percent control of green June beetle larvae and 72.7 percent control of *Phyllophaga* larvae; and the 2-pound application 95.5 percent control of green June beetle larvae and 67.7 percent control of *Phyllophaga* larvae.

The plant bugs *Miris dolobratus* and *Amblytylus nasutus*, and their control.—The plant bug *Miris dolobratus* was not destructive in 1944. Its eggs were found in 2 to 7 percent of the stems of bluegrass after egg-laying ceased. The first nymphs were found April 14 and the first adults May 12. No nymphs were found after May 30 and no adults after June 9. Eggs were found first on May 22. The number of bugs was greatest about May 26. The sexes were about equally divided; 55 percent males, 34 percent short-winged females, and 11 percent long-winged females.

The plant bug *Amblytylus nasutus* was present in some fields of bluegrass in large numbers. Eggs of this bug are placed in the stems of bluegrass near the seed heads and 43 to 79 percent of the stems examined contained eggs. Nymphs began appearing April 26 and adults May 15. Eggs were found first on May 24. The number of bugs was greatest May 22 to May 26, and no adults were found after June 7. The greatest movement of adults took place on May 22 or a few days later. The smallest numbers of bugs were found in fields of young bluegrass, and in fields heavily pastured in 1943. In a late summer examination of infested bluegrass stems which had been clipped after seed harvest, 70 percent of all eggs found were dead. In 62 percent of the stems examined all the eggs were dead; in the other 38 percent of stems there were both living and dead eggs. Less than 1/2 percent of the eggs in unclipped stems were found dead on the same dates. Because of light infestation, the effect of clipping stems after seed harvest, upon eggs of *M. dolobratus*, could not be determined definitely.

Red clover.—Yields of adapted varieties of red clover were low because of the dry and very hot weather that prevailed from early May until mid-August. Ky 215 produced 2,100 pounds of hay per acre from two cuttings, and Cumberland 2,400 pounds. The Southern selection, which usually produces slightly higher yields than other adapted varieties, produced 2,300 pounds. The stand of the Southern selection survived better than those of other adapted clovers after the second cutting and it made better recovery in growth.

Numerous top crosses were made between disease-resistant, vigorous, self-sterile plants of the Southern selection and self-fertile plants

of this same selection in an effort to obtain additional self-fertile lines of breeding value.

Yields of emergency forage crops.—The rapid growth of late-planted forage crops under favorable conditions of soil and moisture is shown by a test following the severe drouth of June and July, 1944. After good rains the last week of July, land was plowed, fitted, and forage seeds were drilled at rates sufficient for a thick stand. Excellent stands resulted, and the crops grew rapidly and were harvested the third week of October. Acre-yields of field-cured hay were:

Corn hay (late boot stage to early tassel).....	10,320 pounds
Sudan grass (heads forming).....	7,760 pounds
Soybeans (pods half filled).....	3,840 pounds
Millet (heads filled).....	3,440 pounds
Buckwheat (seeds mature).....	1,340 pounds

Composition and quality of dew-retted hemp fiber as related to soil fertility.—Fiber from hemp grown on soil high in nitrogen was coarser and weaker than that from plants grown on poorer soil or without nitrogen fertilizer. Hemp grown on soil containing too much nitrogen tends to over-ret, which gives a weaker fiber. Potassium in the fertilizer tended to lessen the bad effect of nitrogen. Pectic substances and pentosans probably help to hold the fiber bundles together, thus increasing breaking strength. The gradual removal of these substances during retting thus may explain the diminution in breaking strength caused by over-retting.

Narcotic property of hemp.—The narcotic property of the seeds and leaves of 6 varieties of hemp was determined biologically and a wide difference was found. It is hoped to produce a narcotic-free hemp, or one in which the narcotic property is negligible.

Cellulose in hemp hurds and tobacco stalks.—By the chlorination method for cellulose determination, average yield of hemp hurds was 53.40 percent and of tobacco stalks 42.40 percent crude cellulose. Both tobacco stalks and hemp hurds would appear to have good possibilities for manufacture of fiberboard, and hemp hurds would also seem to have fair possibilities for paper.

New tobacco varieties.—Ky 41A is rapidly increasing in popularity, 52.2 acres being grown for seed by 39 farmers in 1944, as against 39.4 acres of Ky 16 grown for seed by 24 farmers. There is enough seed of these two root-rot-resistant varieties to plant the entire burley acreage of the United States in 1945.

Several mosaic-resistant (NN) burley varieties, including Ky 54 and Ky 55, produced by repeatedly backcrossing Ky 16 on mosaic-resistant plants of succeeding generations, were tested by farmers and

proved highly satisfactory in mosaic resistance and quality. Whether any of these will yield as well as Ky 16 is yet to be determined.

Ky 34, a new variety of burley resistant to black root rot, fusarium wilt, and mosaic (NN), attracted attention this year. In a test of 12 varieties it yielded about one-third more than any other, and was considered good in quality by federal graders. It will be extensively tested in 1945. It has not stood up well in windstorms.

Aromatic burley was grown by 12 farmers in 1944 to test this new variety for cigarette manufacture.

Ky 150 is a new mosaic-resistant (NN) dark tobacco almost identical (except in resistance to mosaic) with the variety Brown Leaf from which it was developed in 5 successive backcrosses on mosaic-resistant plants derived from Samsoun (NN Holmes). It gave satisfactory results in commercial plantings in Todd county in 1944.

Ky 160 is a new mosaic-resistant (NN) one-sucker variety. It gave satisfactory results in Franklin and Todd counties, in commercial plantings, in 1944. It was developed by 5 successive backcrosses of One Sucker on mosaic-resistant plants derived from Samsoun (NN Holmes).

Bacterial black stalk of tobacco.—This disease was reported for the first time in Bulletin 437 of this Station, 1942. A comparative study was made this year of the causal organism and *Bacillus carotovorus*, *Bacterium solanacearum*, *Pseudomonas fluorescens*, *Ps. aeruginosa*, and *Ps. polycolor*. The causal organism had something in common with the carrot soft-rot organism in pathogenicity, except that it produced a drier soft rot in tobacco stalks, tomato fruits, and in potato than the carrot soft-rot organism. The black stalk organism became systemic in a pepper plant and was isolated from necrotic spots in the fruit on a plant inoculated on the stalk. The typical black stalk was not produced by inoculation of tobacco plants of different ages. The black-stalk organism appeared to be different from any of the organisms with which it was compared.

Root infection with wildfire and angular leafspot organisms.—In tests designed to develop a method by which the roots of tobacco plants bearing the causal agents of wildfire and angular leafspot in the plant bed could be freed of these organisms at transplanting time, it was found that washed roots of wheat or tobacco dipped in a bacterial suspension developed more bacteria than unwashed roots. Plants so treated were potted for 24 to 48 hours, removed, dipped in various chemicals, repotted, and then tested for bacteria at the end of 24 hours. The number of infections which resulted was reduced

from several hundred on untreated roots to a few by treatment of roots with 2-2-100 bordeaux mixture; or 1 part copper sulfate to 400 parts water; or 2-2-100 iron sulfate, hydrated lime, and water. All three of these treatments were effective for the purpose.

Overwintering of *Xanthomonas vesicatoria* on wheat roots.—

In a continuation of studies on the relation between *Bacterium tabacum* and *B. angulatum* and the roots of crop plants, it was found that the tomato pathogen *X. vesicatoria* could also be recovered from roots of wheat plants, during the winter, growing outdoors in nonsterilized soil artificially infected with the organism in the fall. The organism was recovered in each of five tests between December 13, 1943, and March 14, 1944, but not on April 14. *B. angulatum* was recovered again this year from wheat roots during the winter. *X. phaseoli* var. *sojense* and *B. medicaginis* var. *phaseolicola* were not recovered during this period from roots of similar wheat plants growing in soil inoculated with these organisms.

Growth of some animal pathogenic bacteria on wheat roots.—

Pseudomonas aeruginosa, *Corynebacterium equi*, *Salmonella typhi*, *S. paratyphi* A & B, and *S. typhi murium* grew and formed colonies on the surface of seedling wheat roots in pure culture after the roots had been dipped in a culture of the organisms diluted either 1:1000 or 1:10,000. Some of the species could be distinguished on the roots by the size and diversity of colonies and the size of individual bacteria in the colony.

Cercospora* isolates.—Cercospora* cultures have been isolated from 32 species of plants for comparison with *Cercospora* from tobacco, the cause of the common frogeye spot. Seven of these were grown at 15°, 25°, and 35° C. Growth rates and colony types were compared. *Cercosporas* isolated from lupine and festuca are very similar in appearance of colony and in rate of growth, are fairly similar to tobacco *Cercospora*, and somewhat similar to a *Cercospora* from *Potentilla*. *Cercosporas* from petunia and blackberry seem quite different. Cultures from other species were very similar to tobacco cultures, particularly in the rapidly growing vegetative phase. Cultural differences may not be very significant, although in previous studies variations among about 100 isolates from tobacco were not as great as between some cultures from other species.

Control of wireworm injury to tobacco plants.—The wireworm *Conoderus bellus* is numerous in bluegrass sod and attacks young tobacco to some extent when it follows sod in rotations. Adults collected in the spring of 1944 commenced laying eggs on May 3. The extent

of egg-laying was not determined definitely, but eggs have been laid as late as August 17 by over-wintering adults. The average time from egg-laying to the adult stage for 48 rearings was 45 days. The average egg period was 7.3 days, larval period 28.7 days, and pupal period 9 days, for eggs laid May 3 to May 8. Adults of these rearings transformed from pupae June 10 to June 29. No eggs were laid for a second brood of worms. From incomplete rearings in other years, adults have been known to emerge as late as October 5. Over-wintering adults have been kept in cages to September 27. Adults live over winter. Because of the smallness of this worm, the injury it causes could be mistaken for that of larvae of some flea beetles that bore into roots of plants.

Nicotine and other products from green tobacco.—In an attempt to find tobacco varieties with high yields of nicotine, 50 tobacco varieties were grown on heavily fertilized land. Estimated yields of 100 to 130 pounds of nicotine per acre in dried uncured leaf were obtained from eleven of the fifty varieties. Two varieties of *Nicotiana rustica*—Olson 68 and Brasilia—yielded at the rate of 113 and 118 pounds of nicotine per acre, and the dry leaves analyzed 7.5 and 8.1 percent nicotine, respectively. Low topping increased the percentage of nicotine and nicotine yield, but decreased the yield of dry leaves.

Tobacco-seed oil.—Oil was obtained from two lots of tobacco seed by pressing and extraction of the pressed cake. Combined yields were 35 to 40 percent. This oil was used in nutritional studies with white rats and in drying experiments. In digestibility and promotion of growth the tobacco-seed oil compared favorably with butterfat, and its drying properties were slightly inferior to linseed oil. Incorporation of several common driers in the oil reduced the drying time considerably.

Effect of fertilization on the optimum conditions for curing burley tobacco.—The green weight per plant of tobacco from fertilized plots was more than twice that of plants from unfertilized plots, but the percentage loss of weight in curing the tobacco from the fertilized was relatively greater. Further work was done on the moisture-holding capacity of different lots of tobacco at different relative humidities. The cured tobacco from unfertilized plots absorbed more moisture from the air than the cured tobacco from fertilized plots when the moisture content of the air was the same. Tobacco cured at a relative humidity which causes incipient house-burn (about 85 percent) lost more weight during curing than did that cured under more favorable conditions. This resulted in a yield

of cured leaf about 10 percent less than that of samples cured at optimum relative humidity. Since these high relative humidities were common during the 1944 curing season and farmers were unable to obtain enough coke to heat their barns as much as they would have otherwise, the current crop lost in weight as well as in quality.

Change in pigment concentration of burley tobacco during curing.—The chlorophyll content of tobacco leaves was found to decrease after the leaves reached maturity and to continue to decrease more rapidly during curing. Rate of loss was greater in the more mature leaves, whether the maturity was due to position of the leaf on the stalk or to the time when the crop was cut. Although the carotene content of the leaves also decreased, the appearance known as "yellowing" occurred because the loss of carotene was not so rapid as the loss of chlorophyll.

Relative pigment concentration of dark and burley tobacco varieties.—The chlorophyll content, measured per equal leaf area, of 11 burley varieties averaged only half as much as that of 7 dark varieties. In all 11 varieties of burley the chlorophyll content was less than in the dark varieties. About half of the difference was due to thickness of leaf and half to concentration of pigment in a given weight of tissue. Contrary to the visual impression, the amount of carotene in the dark tobacco also was greater than in burley, though the difference was less than the difference in chlorophyll content.

Proportioning heat and ventilation in burley curing barns.—Observations made at the experimental tobacco barn have emphasized the importance of adjusting the rate of firing and degree of ventilation to obtain good curing conditions. The amount of heat required depends primarily upon the amount of ventilation used and the outdoor relative humidity. The required degree of ventilation when fires are used is virtually independent of the outdoor relative humidity and is determined chiefly by the amount of tobacco contained within the barn and the desired range of relative humidity. A wide humidity range between different parts of the barn is undesirable because all the tobacco cannot then cure at the same rate and with uniform quality. On the other hand, a narrow humidity range calls for more heat and ventilation and may not be economical in terms of quality and price. In any event the average humidity should be as near as possible to the optimum of 65 to 70 percent. Whether the rate of firing and degree of ventilation are properly adjusted can be ascertained only by observing the symptoms produced within the barn. If heat and ventilation are each described as high, medium, or low,

there are nine major combinations, each of which produces a different set of symptoms. To illustrate, assume that medium heat and medium ventilation produce good average conditions and a satisfactory humidity range. Then low heat and high ventilation will cause a narrow humidity range and an average humidity well above the optimum. High heat and high ventilation likewise produce a comparatively narrow humidity range but an average humidity below optimum. Medium ventilation causes a moderate humidity range with an average above optimum if the heat is low, and below optimum if the heat is high. Low ventilation produces a moderately wide range with low heat, a somewhat wider range with medium heat, and a very wide range with high heat—the average humidity decreasing in each instance as the rate of firing increases. With so many choices confronting the operator of a tobacco barn, it obviously is not easy to judge offhand whether the heat and ventilation are satisfactory or whether one or the other should be increased or decreased. Good tobacco barn management nevertheless depends upon an understanding of the foregoing relations, especially in view of the fact that it is impossible to formulate a simple rule that will cover all circumstances.

Noteworthy new apple varieties.—HARALSON, previously reported promising, continued to be productive. Trees 7 years old have produced 5 crops ranging from 1 peck to 2 bushels per tree, which is unusual for trees of that age. The fruit is medium to large, has an attractive red color, rates excellent for cooking, good for dessert, and ripens in late August.

ANOKA is one of the earliest to come into bearing, of varieties tested. Trees 2 and 3 years old bore $\frac{1}{2}$ peck per tree. The fruit is small to medium, is excellent for cooking, and ripens in mid-July. It is promising as a variety for the home orchard.

LOBI is a new development of the Transparent type. It resembles Transparent so closely that it can hardly be distinguished from that variety, except that the fruit is larger and ripens a few days later. The trees tested have been productive.

Apple scab.—Spore determinations were made from overwintering leaf samples sent in regularly from Paducah, Henderson, Louisville, and Cold Spring. The wet spring caused early spore maturity and spore discharges continued over a long period, providing ideal conditions for scab infection. In most unsprayed and poorly sprayed orchards there was very extensive early scab infection and loss of small fruit. Where preblossom and early sprays were reasonably well applied, both leaf and fruit infections were kept to a minimum.

Codling moth.— Emergence cages were stocked with 1,000 overwintering codling-moth worms each, and operated at Fulton, Paducah, Princeton, Henderson, Louisville, Lexington, and Cold Spring. Second-brood emergence cages were also stocked and operated at Paducah, Princeton, and Henderson. In addition, codling-moth traps were operated at Fulton, Paducah, Princeton, Sturgis, Henderson, Louisville, Lexington, and Cold Spring. The hot, dry summer of 1944 was one of the worst codling-moth seasons in recent years. Heavy first-brood attacks were followed by heavier second- and third-brood attacks. The "spray service" kept growers informed on moth activity and advised that sprays would have to be more thorough and longer continued than in normal years. Many orchardists following these suggestions had only light losses, while many who neglected the sprays lost complete crops.

Peach pruning.— For a comparison of systems of pruning, Elberta peach trees set in the spring of 1938 were trained by modified-leader and open-center systems, in the Henderson section. In 1944 the modified-leader trees produced an average of $1\frac{1}{3}$ bushel more per tree than the open-center trees. Unpruned trees produced the same amount as the open-center trees, but the fruits were slightly smaller. Trees converted from modified leader to open center yielded least of all because of the heavy cutting. Trees converted to open center in 1942 produced more than those converted in 1943, and those converted in 1943 in turn produced more than those converted in 1944. Some of the lightly pruned modified-leader trees and not-pruned trees are showing a reduction in general vigor and a shading out of fruiting wood low in the trees. Heavier pruning may be needed on these in the near future.

Peach insect survey.— A survey was made in western Kentucky during peach harvest to determine the amount of damage caused by insects. Most of the fruit injury was caused by the plum curculio (9.4 percent) and the oriental moth (7.2 percent). Catfacing, caused mainly by the tarnished plant bug, was lower than usual (3.3 percent). Plum curculio damage was worst on the outer rows and least where the month-before-harvest spray was used. Oriental moth, which caused considerable damage to peaches in 2 commercial orchards near Paducah this year, was least injurious where the parasite *Macrocentrus ancyliivorus* Rohwer had become established.

Parasites of the oriental moth.— To check on the abundance of *Macrocentrus ancyliivorus* Rohwer, insect enemy of the larvae of the oriental moth, collections of infested peach twigs were made in June

in 8 Western Kentucky orchards. From a total of 681 twigs, 156 oriental moths and 7 parasites emerged, indicating that the percentage of parasitism in 1944 was unusually low. *Macrocentrus ancyli-vorus* was recovered from 2 Paducah orchards where the species was introduced in 1943. In September 1944, 3,675 of the adult parasites were liberated in and near 9 peach orchards in the Mayfield-Paducah section.

Plum curculio.—Jarring was done to determine the start and intensity of the spring- and summer-brood curculio attacks. To aid in forecasting, egg development in female adults was studied in relation to spring adult emergence and appearance on the trees. Dissection of newly collected spring adults showed a large majority of the females to contain fully developed eggs by the time the adults were found on the trees. The cool spring delayed the first-brood attack and the hot, dry summer generally reduced and retarded the summer attack. Most western Kentucky peach growers applied the month-before-harvest spray to either the whole orchard or the outside rows and had very light curculio losses, with few exceptions.

Cherry root stocks.—In the spring of 1933 a planting of cherries was made, to test the comparative value of Mahaleb and Mazzard root stocks. Of 10 trees of Montmorency on Mazzard stock, 8 died following the severe winter of 1936 and were replaced. One of the original trees and 3 of the reset trees died following the drouth of 1939. One original tree and 6 replants were in good condition in 1944.

Of 10 trees of Montmorency on Mahaleb stock, 3 died from cold injury the winter of 1936 and were replaced. One of the original trees and 2 of the reset trees died from the drouth of 1931. One tree was removed because of mechanical injury. Five original trees and 5 replants were in good condition in 1944.

Five trees of Black Tartarian on Mazzard stock started growth satisfactorily, but all died during a drouth the first summer. Replants made good growth for two years, but all were winter-killed in early 1936. Of replants in 1936, 2 died after the 1939 drouth, and 3 have survived in good condition.

Of 5 trees of Black Tartarian on Mahaleb stock, all were winter-killed in early 1936, after 3 summers' growth. Replants made good growth during the past 8 years, except one that died after the drouth of 1943.

In this trial, Mahaleb was superior to Mazzard as a stock for Montmorency, because of its greater resistance to subzero temperatures, but Black Tartarian did not survive the severe winter on

either stock. During the period 1937 to 1943, the winters were not particularly severe, and the growth of Montmorency and Black Tartarian on both stocks was good.

During the past 12 years, severe drouths occurred at intervals of 1 to 3 years, and all cherry trees suffered during these periods. All trees on Mahaleb stock withstood the drouths as well as, or better than, those on Mazzard stock.

Nitrogen fertilizer on strawberries.—On soil of the Experiment Station farm at Lexington nitrogen fertilizers on strawberries produced large, vigorous foliage and reduced the yield. For maximum production on moderate to fertile soil, strawberries evidently require little or no nitrogen fertilizer during the second year after planting.

Strawberry field renovation.—Simple scratch-cultivation of the middles, without any special row narrowing, again proved the most satisfactory method of caring for the strawberry field after first harvest. As an average of 2 years, under 3 kinds of renovation treatment, Blakemore and Tennessee Shipper yielded the following amounts:

<i>Treatment</i>	<i>Crates per acre</i>
Middles scratch-cultivated only.....	160
Weeds mowed, no cultivation.....	130
Heavy barring off, 30 days after harvest.....	118

The scratch-cultivated plots gave the highest yields with good-sized berries. Heavy, late barring off required by far the most labor and seriously reduced yield, but the berries on these plots were largest. Plots not cultivated, but on which weeds were mowed above the berry foliage, gave medium yield and small berries that went mostly into the No. 2 and cull grades.

Strawberry mulch.—In cooperative tests in the McCracken county area, early December mulching of strawberries brought an increase in yield, as a 2-year average for 1943 and 1944 of 31 crates per acre for Blakemore variety and 39 crates per acre for Tennessee Shipper. On each variety, 1½ tons of mulch was better than 2 tons. In both winters, however, temperatures at no time were extremely low; in more severe winters the 2-ton mulch might be superior.

Red raspberries.—In a test covering 7 years, at the Lexington farm, with the Latham variety of red raspberry, the plots on which a manure mulch was used averaged 170 crates of berries per acre, whereas the plots not mulched nor fertilized averaged 117 crates per acre. The mulch consisted of fresh manure containing considerable straw, and was applied every other year, in a strip about 2 feet wide and 10 inches deep, along each side of the row. Where nitrogen fertilizer was applied at three different rates, either alone or with the

manure mulch, yields were slightly smaller than those of the untreated checks. Nitrogen fertilizer seemed to make the canes more susceptible to winter injury.

The yields on all plots declined progressively as the planting became older—which seems to indicate that profitable production is limited to the first 4 or 5 crops.

Time to apply fertilizer on potatoes.—In the greenhouse a given amount of nitrogen fertilizer, applied half at planting time and half just after the plants bloom, improved the yield of potatoes more than the same amount applied wholly at planting time. The spring crop of potatoes, with long days and bright sunlight, benefited more from late application of fertilizer than the fall crop, when the days were short and many were cloudy.

Sweet corn: varietal resistance to earworm damage.—Twelve varieties of sweet corn were selected, that were characterized by a heavy, or close-fitting husk, or husks extending well beyond the cob, which might serve to protect the ears from worms. Worm infestation occurred in cycles of moderate to severe damage throughout the summer. During periods of moderate infestation, there was slight variation in the percentage of infested ears, but during severe infestation, all the ears of all varieties were wormy. In the varieties tested, no marked resistance to worminess was found, with the possible exception of Louisiana Sweet.

New varieties of large-seeded lima beans.—Recently the U. S. Department of Agriculture introduced two new varieties of large-seeded lima beans bred to improve productiveness: Early Market and Fordhook 242. These were tested with the standard Fordhook. Early Market matured quickly, produced a large part of its crop early in the season (but the total yield was about the same as Fordhook), and in general appeared to be a highly promising early variety. Fordhook 242, a main-crop type, was more vigorous than Fordhook and about 50 percent more productive. If it shows the same advantage in more favorable seasons, it should replace Fordhook.

Tomato varieties.—In the extra early class, Red Cloud, Sioux, and Valiant were equal to or better than Break O' Day, and possessed superior quality. In the midseason class, Garden State, Rutgers and Marglobe were superior to others tested.

Tomato fruitworm control.—Two baits and three dusts were compared as control measures for fruitworms on Earliana tomatoes, using each treatment on 6-plant plots, replicated 6 times. Six randomized check plots were left untreated. Applications of insecticides

were made on June 10, 17, and 23 and counts of clean and injured fruit made from June 20 to July 26. For the period June 10 to July 13, 10.1 percent of the fruit was injured by fruitworms on plots treated with bait made of lead arsenate and cornmeal (1 to 10), 11.6 percent injured on plots treated with DDT (3 percent in Pyrax ABB), 11.9 percent injured on plots treated with bait made of cryolite and cornmeal (1 to 10), 18.4 percent injured on plots treated with undiluted calcium arsenate, and 19.3 percent on plots treated with cryolite-Pyrax ABB dust. On the check plots, where no insecticides were used, 29.9 percent of the fruit was injured. The same materials were also compared on a canning crop of Rutgers tomatoes later in the season, but no fruitworm infestation developed. DDT (3 percent in Pyrax ABB) was the only dust as effective as the two baits used.

Effect of boron on the soluble and insoluble nitrogen fractions in spinach.— This experiment was designed to ascertain the effect of different levels of boron varying from amounts so low as to produce symptoms of deficiency to amounts large enough to cause slight toxicity, on the production of insoluble or protein nitrogen by spinach. As the concentration of boron in the nutrient solution was increased, the percentage of insoluble or protein nitrogen increased in a regular fashion and the soluble nitrogen content decreased. The boron evidently had no appreciable effect on nitrogen absorption, but it influenced protein metabolism.

Effect of boron on the carbohydrate and nitrogen metabolism of radishes.— Radishes were grown under levels of boron varying from none to 5.0 ppm, and the tops and bulbous roots were analyzed separately for direct reducing sugars, sucrose, easily hydrolyzable insoluble carbohydrate, soluble and insoluble nitrogen. Direct reducing sugars and sucrose were present in excessive amounts in the tops of boron-deficient radishes while in the bulbous roots direct reducing sugars were very low in the boron-deficient plants and increased regularly as the boron application increased. Sucrose was found to be very high in the bulbous roots of boron-deficient plants and low in all to which boron had been applied. Easily hydrolyzable insoluble carbohydrates were present in excess in both tops and roots of boron-deficient radishes.

The level of boron seemed to have little effect on the soluble nitrogen content of the radish tops but excessive amounts were found in the bulbs of the deficient plants.

Bluegrass-molasses silage versus alfalfa-molasses silage for steers fattening in drylot.— Two similar lots of 10 good to choice

western yearling Hereford feeder steers each were fed in drylot for 140 days. Both lots were fed 4 pounds of "U.S. No. 2" first-cutting alfalfa hay per steer per day plus an equalized full feed of yellow shelled corn, with free access to salt, ground limestone, fresh water, and shade. Alfalfa-molasses silage made from first-cutting alfalfa was fed to lot 1, and bluegrass-molasses silage made from bluegrass coming into bloom was fed to lot 2. Each silage was fed in such quantities as would contain approximately the same total amount of dry matter as the 4 pounds of hay. The steers in lot 1 gained 2.35 pounds per head per day and averaged 60.1 percent carcass yield. The carcasses graded 3 "U.S. Good plus," 3 "U.S. Choice minus," and 4 "U.S. Choice." Prewar grade standards were used. The steers in lot 2 gained 2.30 pounds per head per day and averaged 60.0 percent carcass yield. The carcasses from this lot graded 2 "U.S. Good minus," 3 "U.S. Good plus," 2 "U.S. Choice minus," and 3 "U.S. Choice." Leaving out of account the two slowest-gaining steers in each lot, the steers fed bluegrass silage had a slightly higher average daily gain than, and the same carcass grades as, the steers fed alfalfa silage. Though both silages were of good quality, the steers seemed to like the alfalfa silage better.

Feeding values of some pasture forages for steers.—Forty-nine digestion tests have been completed during the past 5 years, using yearling feeder steers and some common fresh pasture forages in different stages of maturity. Among other things, the results of these tests indicate that as the following cover-crop forages advance in maturity from the young, preheading stage to the early-heading stage there is a decrease in their total digestible nutrients and digestible crude protein, respectively, and on a dry-matter basis, as follows: rye, 5 and 38 percent; wheat, 10 and 53 percent; Ky 1 barley, 6 and 29 percent, and Italian ryegrass, 8 and 4 percent. Korean lespedeza in early bloom contained 6 percent less total digestible nutrients and 20 percent less digestible crude protein per pound of dry matter than similar forage in the young, prebloom stage of maturity.

In accompanying consumption studies, steers ate the four cover-crop pasture forages as follows (ranked in descending order according to amount of total digestible nutrients consumed per hundred pounds of steer per day): Preheading stage—Ky 1 Barley, rye, Italian ryegrass, and wheat. Early-heading stage—Ky 1 Barley, Italian ryegrass, wheat, rye. These data indicate that, with advancing maturity, rye loses its palatability more rapidly than its digestibility.

Grade of steer desirable for slop feeding.—Three lots of 10 steers each were fed slop and hay for 140 days. Lot 1 steers were western Herefords averaging 791 pounds at the start of the test, grad-

ing "U.S. Low Choice" to "U.S. Choice," and carrying between 50 and 100 pounds more flesh than desirable for slop-feeding. Lot 2 were western Hereford steers grading "U.S. High Medium" to "U.S. Low Good" and averaging 687 pounds at the start of the test. Lot 3 steers were of mixed dairy and beef breeding, grading "U.S. Common," showing evidence of averaging at least 50 percent of beef blood, and having an average initial weight of 752 pounds. The steers in lots 2 and 3 were in ideal flesh for slop feeding. Those in lot 1 were of better type, conformation and quality than most of the steers used for slop feeding in Kentucky. Those in lot 2 were at least up to the average of western feeders commonly used for slop feeding, and those in lot 3 were better than the average native steers of mixed breeding used for this purpose. All three lots were fed all the whole-wheat slop they would eat plus 5 pounds of medium- to low-grade mixed hay per steer per day with salt and ground limestone self-fed. The daily average consumption of slop per steer was: lot 1, 21.96 gallons; lot 2, 20.84 gallons; and lot 3, 22.43 gallons.

The steers of mixed dairy and beef breeding were most profitable for slop feeding in this test.

The lot 1 steers made an average daily gain of 1.91 pounds per head, dressed 61.50 percent, and yielded carcasses grading from "U.S. Low Good" to "U.S. High Good" and averaging "U.S. Good." The lot 2 steers made an average daily gain of 1.85 pounds per head, dressed 59.35 percent, and yielded carcasses grading from "U.S. Common" to "U.S. Low Good" and averaging "U.S. Medium." The lot 3 steers made an average daily gain of 2.37 pounds per head, dressed 59.42 percent and yielded carcasses grading from "U.S. Low Common" to "U.S. Good" and averaging "U.S. Medium." Upon slaughter, one steer in lot 3 was found to have an abscessed liver and adhesions. Since unhealthiness is not uncommon among native steers of mixed dairy breeding available on the market for slop feeding, this steer's performance was not ruled out of the data. If it had been, the average daily gain of lot 3 would have been 2.53 pounds per head.

Distillery slop from corn and wheat, whole wheat, and granular wheat flour, for fattening steers.—Three similar lots of 10 "U. S. Low Good" to "U.S. Good" western Hereford yearling feeder steers each were fed for 224 days on different distillery slops plus 5.04 pounds of low-grade mixed hay, 0.12 pound of salt and 0.10 pound of ground limestone per steer daily. Lot 1 steers ate an average of 20.44 gallons per steer daily of slop from granular wheat flour (bran and germ removed). This slop was strained but the recovery of wet grains was slight. Lot 2 steers ate an average of 21.94 gallons per

steer daily of an unusually thick whole-wheat slop. Lot 3 steers received an average grade of whole slop produced from a mash of 44.25 percent each of ground yellow corn and ground whole wheat and 11.50 percent barley malt until the 169th day, when they were changed to thin corn-and-wheat slop from another distillery. Their average daily slop consumption was 19.51 gallons.

The average daily gains per steer for the first 168 days were 1.69, 2.00, and 1.93 pounds, respectively, for lots 1, 2 and 3. During the next 56 days the steers in lot 1 gained a total of 512 pounds and those in lot 2, 450 pounds, whereas the steers in lot 3 made a total gain of only 16 pounds. These data indicate that the change in slops was decidedly detrimental to the performance of the lot 3 steers. For the entire 224-day period the average daily gains per steer for lots 1, 2 and 3 were 1.50, 1.70, and 1.45 pounds respectively. The average solid content of the slops fed the three lots were 6.36, 8.06, and 7.20 percent respectively. No signs of nightblindness, an early indication of vitamin A deficiency, were observed in any of the lots. All three lots produced carcasses that averaged between "U.S. Good" and "U.S. high Good" in grade, with lot 2 averaging slightly the best and lot 1 slightly the poorest. The average carcass yields of lots 1, 2 and 3 were 60.76, 61.68, and 60.20 percent, respectively, based on cold carcass and sales weight of the cattle.

Alfalfa hay versus red-clover hay for pregnant and lactating ewes.—Two comparable lots of 10 western ewes were fed from November 19 to April 28 in drylot. Ewes in lot 1 were fed 4 pounds of "U.S. No. 2 plus" alfalfa hay per ewe per day, those in lot 2, 4 pounds of "U.S. No. 2 plus" red-clover hay, and those in both lots $\frac{1}{2}$ pound of shelled yellow corn before lambing and 1 pound after lambing. Salt, ground limestone, bonemeal, and fresh water were available at all times. A very marked difference, in favor of the alfalfa lot, was noted in the final condition of the ewes and in their ability to maintain body weight while suckling their lambs, a period of about 11 weeks. Consistent with the results of other similar tests, the ewes in the alfalfa lot gave birth to the greater number of lambs. No significant difference was noted in the average daily gains or strength at birth of the lambs from the two lots of ewes, though the lambs from the alfalfa group were slightly heavier at birth.

Alfalfa, bluegrass, and corn silages for pregnant and lactating ewes.—Four comparable lots of 10 western ewes each were fed in drylot from November 19 to April 28. Each ewe in lot 1 received 4 pounds of alfalfa hay per day, and each ewe in lot 2 half as much of the same hay plus enough bluegrass-molasses silage to provide an equal

amount of dry matter. Lots 3 and 4 were fed the same as lot 2 except that the silage for lot 3 was alfalfa-molasses and that for lot 4 was corn. Ewes in lots 1, 2 and 3 were fed $\frac{1}{2}$ pound of yellow shelled corn per ewe per day before lambing and 1 pound after lambing. The ewes in lot 4 were fed one-fifth of a pound of soybean oilmeal per head daily and no corn, since the amount of corn silage fed contains grain equivalent to 1 pound of shelled corn, but is low in protein. Salt, bonemeal, and ground limestone were self-fed separately to all lots. Lot 2 produced the most lambs, the strongest lambs, and the heaviest lambs at birth. The lambs in this lot also made the fastest gains but their dams did not maintain their condition as well as the ewes in the other three lots. The relative desirability of the three other rations, measured by the above standards, was: second, alfalfa-molasses silage; third, alfalfa hay; and corn silage a very close fourth. All the rations produced quite satisfactory results. The alfalfa hay graded "U.S. No. 2 plus." All the silages were very good but not excellent in quality.

Methods of finishing late lambs.—Forty-five late lambs out of various types of western ewes and sired by purebred Southdown rams were selected for this experiment. All were in good, thrifty condition. They were sheared on July 7 and 8 and yielded fleeces averaging 2.17 pounds. On July 13, 14, and 15 the lambs were weighed (range, 46 to 66 pounds; average, 57 pounds) and divided into five comparable lots, taking into consideration breeding, age, weight, finish, and previous gains. Lot 1 thereafter was given bluegrass pasture only; lot 2, bluegrass pasture plus a full feed of shelled corn daily; lot 3, alfalfa pasture only; lot 4, lespedeza pasture only; and lot 5, soybean pasture only. All lambs were provided with fresh water and shade and were given free access to a 9-to-1 salt-phenothiazine mixture. The flock from which these lambs were taken had been drenched with phenothiazine the preceding November and May.

Drouth from late April until early August slowed the growth of pasture, especially the bluegrass. Dogs attacked the lambs in lots 1 and 2 on September 11 and all lambs in these two lots had to be disposed of. The average daily gains up to September 8 were 0.146, 0.331, 0.414, 0.375, and 0.269 pound per lamb, respectively, for the five lots. The lot 2 lambs ate an average of 1.37 pounds of shelled corn per day per lamb, in the 59 days they were on test. Since this was practically a full feed of corn for lambs of this size, the bluegrass forage was apparently consumed in very moderate amounts. Consumption of corn decreased soon after the early August rains produced an abundant new growth of forage.

Lots 3, 4, and 5 were continued on pasture until September 22, their average daily gains for the full 70 days being 0.373, 0.388, and 0.293 pound per lamb for the three lots, respectively. The lambs were slaughtered September 25. Those in lot 3 dressed 51.2 percent and yielded carcasses averaging "U.S. High Choice" using pre-war grading standards; those in lot 4 dressed an average of 52.9 percent and yielded carcasses averaging "U.S. Low Prime" and those in lot 5 dressed an average of 52.1 percent and yielded carcasses averaging "U.S. Low Choice." The intestines of all lambs slaughtered were free from nodules and tapeworms. Very few common stomach worms were found and little evidence of other parasites was noted. It is quite significant that these late spring lambs produced choice to prime carcasses by late summer, without having had any grain.

Grain for creep-fed suckling lambs.—Suckling spring lambs creep-fed cracked yellow shelled corn to an average age of about 5 months ate 10 percent less grain, gained 4 percent faster, and reached the same market grade as did similar lambs creep-fed a mixture of 3 parts cracked yellow shelled corn and 1 part of a commercial milk substitute reputed to contain desirable growth-promoting and fattening substances not found in farm feeds. No difference was noted between lots in the relative performance of either twins or singles. The dams of these lambs were well-fed, mottled-faced western ewes of good type and in good condition. These results confirm those of five previous creep-feeding tests in which corn alone proved superior to complex grain mixtures in both economy of gain and market quality of lambs.

Continuous versus rotational grazing for unweaned spring lambs.—Eleven unweaned spring lambs that grazed three 1.15-acre bluegrass fields in rotation at 2-week intervals gained 8 percent faster than 11 closely comparable lambs which grazed continuously on an adjacent 3.45-acre field of bluegrass. In 8 previous tests there was an average difference of 5.2 percent in favor of rotational grazing. Each year the areas used for the two systems of grazing have been reversed so as not to favor either system with the better field, which has proved to be the field used for continuous grazing in this year's test. The flock used in this test was drenched with phenothiazine both in late fall and in spring, and had access to a 1:9 mixture of phenothiazine and salt while on pasture. An application of ammonium nitrate made in the spring on both the rotationally and the continuously

grazed areas may have resulted in the relatively better showing made by the rotational grazing this year.

Longevity of Haemonchus contortus larvae on pasture in summer.—Ammonium nitrate was applied on each of 3 plots 10 x 20 feet on bluegrass sod. Plot 1 received a daily application of 1½ to 2 gallons of sheep feces from June 15 to June 28, inclusive, and was watered daily during this period. The feces were from sheep infested with *Haemonchus contortus*. In the same manner, plot 2 was contaminated June 29 to July 12, and plot 3 July 13 to July 26.

Examination of the plots for *Haemonchus contortus* larvae by the Baerman technique began on October 1. The exposure periods from date of the last application of feces until tested for larvae were 94, 81, and 66 days for plots 1, 2, and 3, respectively. No larvae were found on plot 1 in a series of 12 Baerman examinations.

For biological testing of the plots, 6 lambs were treated twice with phenothiazine, and between the treatments were given access to a mixture of phenothiazine and salt, 1 to 9. Examination of feces from the lambs on October 1 failed to show *Haemonchus contortus* ova. Two of these lambs were placed on each plot October 1, and remained on the plots continuously for 13 days. They were then removed to a clean pen with concrete floor. Slaughter of the lambs began 23 days after their removal from the plots. From the respective plots an average per lamb of 25, 75, and 200 adult *Haemonchus contortus* were found. Evidently, therefore, a pasture not used by sheep during July, August, and September, would become almost free of *Haemonchus contortus* larvae capable of establishing themselves in lambs.

Sheep diseases.—During the year, autopsies were held on 73 lambs from 50 flocks and 36 ewes from 30 flocks. From the 109 sheep examined, 33 different pathological conditions were recognized. Internal parasitism continues to be the major source of trouble, accounting for 14.15 percent of the cases. Malnutrition was next in importance with 11.32 percent, and sporadic pneumonias associated with inadequate feeding accounted for 6.60 percent. The remaining 68 percent were distributed almost evenly among 30 pathological conditions of sporadic and incidental nature which seldom cause serious death loss in a flock. Likewise these conditions are not important as causes of poor health or low reproduction among ewes, and, except in a few individuals, are not a significant cause of slow growth and late marketing of lambs. Many of these conditions are a result of faulty management practices and lack of cleanliness.

Distillers' dried solubles as a protein supplement for fattening hogs in drylot.—Four lots of 8 100-pound pigs each were fed in drylot until the pigs averaged slightly more than 200 pounds each. Lot 1 was self-fed a mixture of ground corn and tankage in the proportion of 9 to 1. Lot 2 received a mixture, self-fed, of ground corn and soybean oilmeal in the proportion of 5.5 to 1. Lot 3 was self-fed a 3.8 to 1 mixture of ground corn and distillers' dried solubles. Lot 4 had ground corn and distillers' dried solubles self-fed in separate hoppers. The grain mixtures fed to lots 1, 2, and 3 contained about the same percentage of crude protein. All lots were self-fed a mineral mixture of 4 parts ground limestone and 1 part salt.

Pigs in lot 1 averaged 1.98 pounds daily gain and required 396 pounds of feed mixture and 0.8 pound mineral mixtures for each 100 pounds gain. Pigs in lot 2 gained most rapidly, averaging 2.06 pounds daily, and required only 374 pounds of feed mixture and 1 pound mineral mixture for each 100 pounds gain. Lot 3 pigs made an average daily gain of 1.55 pounds, requiring 495 pounds of feed mixture and 1 pound of mineral mixture for each 100 pounds gain. The pigs in this lot sorted out the solubles and thus much of this feed was not eaten. For the first four weeks lot 4 made an average daily gain of only 1.38 pounds and required 354 pounds of corn, 2.59 pounds distillers' dried solubles and 3.9 pounds mineral mixture for each 100 pounds gain. During this first period, these 8 hogs consumed only 8 pounds of distillers' dried solubles or a little less than 0.6 ounce per pig daily. For the next 2 weeks the protein supplement for this lot was a mixture of 9 parts soybean oilmeal and 1 part distillers' dried solubles, by weight. During this period these hogs made an average daily gain of 2.66 pounds each and ate 180 pounds corn, 60 pounds protein supplement and 0.3 pound mineral mixture for each 100 pounds gain. For the next two weeks, the protein mixture was made up in the proportion of 8 parts soybean oilmeal and 2 parts of distillers' dried solubles, by weight, and self fed. The average daily gain per pig was 2.04 pounds, requiring 251 pounds corn; 104 pounds protein mixture and 1.8 pounds mineral mixture for each 100 pounds gain.

The pigs in lots 3 and 4 disliked the distillers' dried solubles used in this test, perhaps because of the unusually high acidity of the dried solubles.

Diseases of hogs.—The major causes of death or failure to grow and gain in weight among hogs from 137 herds examined were hog cholera (29.2 percent of the herds), nutritional disorders (27.7 percent), and parasites (12.4 percent). Death or unthriftiness due to

nutritional disorders was found to be due primarily to feeding an unsupplemented ration of distillery slop, wheat, or barley. Most serious nutritional disorders were encountered in pregnant and nursing sows, in suckling pigs, and young shoats. It was evident that insufficient carotin (vitamin A) caused most of the nutritional disorders, and next was the fact that the animals received little or no animal protein as a supplement.

Bacteriological examination of the hogs suffering from nutritional deficiency usually revealed the presence of bacteria as an organic or systemic infection. Such bacteria find ready entrance into the blood and tissues of pigs that are undernourished, heavily parasitized, and maintained under insanitary conditions.

Dry matter and crude protein in bluegrass and Korean lespedeza pasture at different stages of growth.—Bluegrass grown to maturity on a given area produced much more total dry matter, but only about $\frac{1}{3}$ as much crude protein as bluegrass grown on an equal area repeatedly clipped. The fall growth of bluegrass was more proteinaceous than that of spring and summer. The total forage production of unclipped Korean lespedeza was about 3 times that produced in the same time on an equal area frequently clipped. Livestock grazing young or frequently clipped bluegrass therefore consume more proteinaceous feed and get more protein per acre than if they had grazed the same area after it had been allowed to mature. Grass evidently continues to make protein in preparation for a fruiting stage which, because of clipping (or adequately close grazing) does not occur.

Spring or summer bluegrass pasture versus bare range for laying hens.—The consumption of young, growing bluegrass by hens was materially larger than their consumption of mature bluegrass, and saved about 20 percent of an all-mash ration. The Heiman-Carver Roter readings of the egg yolks were 13, 14, and 15 when the hens had access to a bare lot, mature bluegrass, or spring bluegrass pasture, respectively. Access to spring-growing or mature-summer bluegrass pasture did not influence the average weight of the eggs, of the wet or dry yolks, or of the dry shells. Neither bare nor bluegrass range influenced the weight of chicks hatched. The greatest difference in droppings from the hens in these lots was the smaller percentage of nitrogen-free extract when hens had access to spring bluegrass. Gross energy values of the droppings were not influenced by access to bare lot or bluegrass pasture. The refractive index of the egg yolk fat did not show any marked or orderly variation during the experiment. Pasture in the ration of laying hens thus saved 20

percent of the mash feed and had no detrimental effects on the hens, the eggs, or the chicks hatched from the eggs.

Comparison of fats in laying pullets and yearling hens.—Subcutaneous, intro-abdominal and neck fats from laying White Leghorn pullets had approximately the same iodine number, and the refractive index was the same in these fats. This was true also of these fats from laying hens, though these functions were greater for the fats from the older hens. Color of the fats in both ages and all locations was the same. In the yearling hens the weight of oil from the uropygeal gland was about 25 percent heavier than in the pullets. The iodine number of this oil was larger but the refractive index was appreciably lower in the yearling hens than in the pullets.

Age and reproduction in the hen.—Effects of age on egg production, fertility, hatchability (including stage of embryo mortality), and egg weight were observed in White Leghorn hens in a flock maintained for the last 15 years by use of tested hens 3 or more years of age.

Egg production, fertility, and hatchability declined with increasing age though hens that completed more than 3 years of egg production produced more eggs in their third year than those that completed only 3 years of production, and similarly for comparisons in more advanced years. Embryo mortality in each of the 3 weeks of incubation increased at essentially the same rate with advancing age of the hen. Egg weight reached a maximum in the second year and then declined slightly. The use of aged hens having favorable records for number of eggs, fertility, and hatchability is highly desirable in a constructive breeding program even though it is usually best to use only pullets in a general farm flock maintained for egg production. These results are in essential agreement with those reported by other workers on less highly selected hens.

Vegetable versus animal protein for laying pullets.—In this experiment all ingredients and mashes were hopper-fed and water was always available. The materials fed to the different pens were as follows, pen 1 being confined and the other pens with access to bluegrass pasture:

- Pen 1 Laying mash containing animal protein; yellow corn, and limestone.
- Pen 2 Soybean oilmeal with 2 percent of salt added, steamed bonemeal, limestone, and yellow corn.
- Pen 3 Soybean oilmeal with 2 percent salt added, limestone, and yellow corn.
- Pen 4 Laying mash containing soybean oilmeal and no animal protein; limestone, and yellow corn.

The results for the first year of the experiment were as follows:

	Average egg production per hen	Hatch- ability, percent	Average egg weight, ounces per dozen
Pen 1, animal protein	188	78	24.8
Pen 2, vegetable protein and bonemeal.....	196	78	25.5
Pen 3, vegetable protein	182	74	24.8
Pen 4, vegetable protein mash	199	75	24.9

These results indicate that soybean oilmeal may be used to replace animal sources of protein in the ration of laying pullets, if properly supplemented by green pasture and a source of phosphorus such as steamed bonemeal.

Strength of sodium chloride solutions toxic to chicks.—Five groups of twenty-five chicks each were given 0.25, 0.50, 0.90, 1.50, and 2.0 percent solutions of chemically pure sodium chloride as drinking water. Toxic symptoms were noticed on the second day from the 1.5 and 2.0 percent solutions, the symptoms being somnolence, convulsions, incoordination, and opisthotonos. All chicks of these two groups were dead in four days. Among the chicks receiving water with 0.90 and 0.50 percent salt, symptoms appeared on the 4th and 5th days, consisting of pronounced corporeal edema and respiratory distress. The death rate was high up to the 14th day. No toxic symptoms were noted from the 0.25 percent solution except thirst and unkempt appearance of the chicks. The growth rate was not affected in the 0.25-percent group and was not significantly reduced in the 0.5-percent group, but was markedly reduced in the 0.9-percent group. Gross pathological changes were a pronounced edema and marked degenerative change of the solid visceral organs.

Resistance of chickens to louse infestation.—Recent experiments indicate that there is some basis for the common observation that White Leghorns have more lice than some of the colored breeds. Two houses of louse-free birds were established in early September, using part White Leghorns and part Rhode Island Red chickens in each house. In November a number of live body and shaft lice were placed on one red and one white hen in each house. The two breeds were then left together during the winter and in April all the hens were deloused and the lice collected from each bird. In one house Rhode Island Reds averaged 37.7 body lice per bird, and White Leghorns averaged 122.6. In the second house Rhode Island Reds averaged 96.5 body lice and 8.7 shaft lice per bird, whereas White Leghorns averaged 175 body lice and 18.5 shaft lice per bird.

Palatability of phosphorus supplements for dairy cattle.—The entire herd of cows of milking age, of the Experiment Station, was

given free access to salt, special steamed bonemeal, fused rock phosphate and dicalcium phosphate in separate hoppers. Gross consumption may be taken as a rough estimate of relative palatability. From September 11 to December 11, 3,607 cow-days, the cows consumed 113.1 pounds of salt, 30.2 pounds of bonemeal, 6.0 pounds of fused rock phosphate and 0.3 pound of dicalcium phosphate. In the presence of bonemeal the cows used bonemeal, 83 percent; fused rock phosphate, 16 percent; and dicalcium phosphate, 0.8 percent. During this time the herd was fed a well-balanced ration and there was little likelihood that a very pronounced craving for phosphorus supplements would exist.

Alternate versus continuous grazing of permanent pasture by dairy heifers.—For the first eight years of this experiment the western half of the experimental pasture was grazed alternately and the eastern half continuously, during the pasture season. At the start of the 1944 season, however, this order was reversed. Heifers were turned on the pastures April 14 and removed November 10, a period of 30 weeks, or 210 days. The maximum number of heifers per 5.8-acre plot was 11 through parts of May and June and the minimum 3 during parts of July and August while there was a rather severe drouth.

Heifers on the continuously grazed plot gained 433 pounds per acre and those on the alternately grazed plots gained 361 pounds per acre. The amount of total digestible nutrients necessary for body maintenance of the heifers on the two plots was calculated to be 1,288 and 1,289 pounds, respectively, and for the gains in weight of the heifers, 1,533 and 1,281 pounds per acre. According to these calculations, the continuously grazed pasture furnished 2,821 pounds of total digestible nutrients per acre and the alternately grazed pasture 2,570 pounds per acre. This would be about 7.6 and 6.9 tons (green weight) of bluegrass per acre. The continuously grazed plot grazed continuously this year gave slightly higher yields than the other part of the pasture in seven out of the eight seasons during which it was grazed alternately.

Bovine mastitis studies.—From 318 cows in 7 herds under observation during the year, 1,714 milk samples were obtained for examination. One or more cultures were isolated from each of 167 cows for identification and study. Of the cultures identified, there was a ratio of approximately 7 cultures of *Streptococcus agalactinae* to 3 of *Streptococcus uberis*. The former type predominated in three of the herds and the latter in the other four. In one herd *S. uberis*

only was found, while in the other six herds both were found. Vaccination procedures with specific bacterial extract vaccines are being carried out in 5 of the 7 herds.

Salmonella abortivo-equinus vaccine.— Enough vaccine to immunize 887 mares on 27 farms against *Salmonella abortivo-equinus* was prepared during the year by the Animal Husbandry Department.

Equine virus abortion.— In the 1943-44 season 499 mares in 17 bands were vaccinated with liver-extract vaccine. Nine bands were vaccinated before abortion occurred. In one of these bands there were 3 abortions later in the season; in the other eight there were no abortions. In 8 of the 15 bands vaccinated one or more mares had aborted before vaccination. After vaccination of these bands the number of abortions were:

Band 1.....	10 mares vaccinated; no abortions
Band 2.....	70 mares vaccinated; 6 abortions
Band 3.....	68 mares vaccinated; 7 abortions
Band 4.....	10 mares vaccinated; no abortions
Band 5.....	15 mares vaccinated; 3 abortions
Band 6.....	16 mares vaccinated; 5 abortions
Band 7.....	4 mares vaccinated, no abortions (2 had aborted before vaccination)
Band 8.....	Exact data not available; no abortions 3 weeks after vaccination

In band 5 the mares were separated into small groups, providing very complete isolation and every known precautionary measure. In band 6, facilities for isolation were not available and no special procedures except vaccination were taken to control the disease. In this band 2 foals died at birth (term) and 1 at nine days of age.

Periodic ophthalmia.— Horses with normal eyes have been subjected to contact exposure (cohabitation in box stalls and pasture) with horses having periodic ophthalmia. Six horses have been thus exposed for 7 years, two for 6 years, two for 5 years, and one for 4 years. Another group of seven horses have been similarly exposed, for a period averaging 26 months for the group. Six others have had contact exposure to periodic ophthalmia for a period averaging 9 months. No ophthalmia has occurred in any of the horses thus exposed.

One horse which received separate intrapalpebral injections of vitreous humor, aqueous, and vitreous humors, and filtrate of ground uvea from acute cases of periodic ophthalmia has normal eyes at 7 years after the inoculations.

Four foals from a mare having chronic periodic ophthalmia have

been under observation since birth, one for 5 years, one for 2½ years, one for 1½ years and one for 6 months. No evidence of periodic ophthalmia has developed in the four colts produced by this mare.

Occurrence of *Salmonella* and paracolon bacteria.—Of 2,261 cultures examined, 1,482 were of animal origin and 788 were from man. Of these, 1,327 animal cultures and 680 human cultures were found to be *Salmonella* and were identified by serological methods. Among these 2,007 *Salmonella* cultures, four new types were recognized, as follows: *S. concord* (VI, VII:1,v-1,2,3 ...), *S. inverness* (XXXVIII:k-1,6...), *S. loma-linda* (IX,XII:a-e,n,x...), *S. pomona* (XXXVIII:y-1,7...), *S. salinatis*, *S. litchfield*, and *S. illinois* were recognized for the first time in man. *S. simsbury*, *S. berta*, and *S. zanzibar* were encountered for the first time in infections of domestic animals. In an outbreak of *S. pullorum* infection in canaries (*Ferinus canarius*), the first reported occurrence of *S. pullorum* in this species, 50 of 75 birds in the affected flock died.

In continued studies of paracolon bacteria related serologically to certain *Salmonella* strains, a number of new types were recognized, all having antigenic relationships to paracolons previously studied. In addition to their isolation from animals, they have now been found in animal food products and in man. Cultures of this group are being encountered with increasing frequency, more than 200 cultures having been collected and studied.

The antigenic formulas of 3 new *Salmonella* types (*S. georgia*, *S. kensington* and *S. richmond*) were confirmed for workers in other laboratories. A number of workers from other laboratories were trained in the serological identification of *Salmonella* cultures.

Arsenic in animal nutrition.—The growth of young rats fed two rations of low arsenic content was not benefited by addition of sodium arsenate equivalent to 10 parts of the element per million of the feed. Arsenic in the diet at a concentration of 50 ppm proved slightly toxic, as indicated by retarded growth.

Boron in animal nutrition.—When young rats were fed a ration containing only 51 ppm of potassium, their survival periods were lengthened significantly by inclusion of 100-1000 ppm of boron in the form of either boric acid or borax. Of 54 pairs upon which the survival study was made, there were 33 in which the boron-fed animals lived significantly longer than the respective low-boron mates as compared with only 8 in which the opposite result was obtained. After 3 weeks on the respective diets 21 high-boron rats contained 9.3 percent of body fat as compared with 8.5 for the low-boron mates.

The concentration of glycogen in livers of the same rats averaged 1.57 and 3.11 percent, respectively.

Addition of 500 ppm of boron to rations containing 5 and 7 percent, respectively, of potassium chloride resulted in slight retardation of growth.

Manganese in ascorbic acid synthesis.—The claim that guinea pigs can synthesize ascorbic acid from injected mannose if a manganese salt is injected simultaneously appears questionable in light of results obtained during the year. Using the response in blood phosphatase as an index of synthesis of ascorbic acid (the concentration of the enzyme is related to intake of this vitamin) little difference due to manganese was observed. In the 25 instances where an injection of mannose solution was made on 3 successive days, the average concentration of phosphatase dropped from 5.06 units per 100cc to 2.50. In 37 instances where manganese was injected in addition to mannose, the concentrations averaged 4.11 and 2.34 units per 100cc, respectively, before and after the series of 3 injections. However in the latter group there were 8 small though positive responses as compared with only one in the former group. Invariably when ascorbic acid was injected, there was a marked rise in phosphatase, the average increase being 6.46 units following 3 daily injections of 10mg of the vitamin.

Effect of methods of cooking fresh and cured pork, and of canning fresh pork, on the thiamin and niacin content.—Investigation of the effect of curing, canning, and different methods of cooking on the vitamin content of fresh and cured pork was extended and continued as part of the national cooperative project on conservation of the nutritive value of foods. The 4 hogs used were raised under uniform conditions at the Experiment Station Farm during the fall and winter, whereas those used in a similar experiment reported last year (56th Annual Report) were raised during the previous spring and summer. Loin, ham, shoulder, spareribs, and liver were the cuts analyzed. The left ham and shoulder were salted and smoked. Cooking methods were those approved by the Committee on Preparation Factors of The National Cooperative Meat Investigations.

The thiamin and niacin contents were of the same order for the fresh cuts cooked by the various methods, as those already reported for the first set of 4 hogs, although thiamin values for loin and ham were slightly higher for the last 4 hogs. Other thiamin values found to be higher in the last 4 hogs than in the first 4 were: raw shoulder, 6.6 percent higher; raw spareribs, 8.6 percent higher; boiled spare-

ribs, 22.1 percent higher; raw liver, 2.5 percent higher; boiled liver, 13.8 percent higher; and fried liver, 4.3 percent higher. All of these values were calculated on the dry basis.

A quarter of a pound, which is about an average serving, of the raw fresh edible portion of these cuts, when cooked in various ways, contained the following amounts of thiamin in micrograms: roast loin, 326; boiled ham, 233; roast ham, 257; and fried ham, 435; boiled, roast, and fried shoulder, 229, 232, and 337 respectively; boiled and roast spareribs, 218 and 312 respectively; boiled, roast, and fried liver, 279, 428, and 389 respectively. Considering the recommended daily allowance as 1.5 milligrams of thiamin, an average serving of these cuts would supply 12 to 29 percent of that requirement, depending on the cut and the method of cooking.

The niacin values for the different cuts were higher for the last four hogs with the exception of raw ham, roast shoulder, and boiled spareribs, which were somewhat lower. An average serving of fresh, edible portion of these cuts, cooked in the various ways, contained the following amounts of niacin in milligrams; roast loin, 1.73; boiled, roast and fried ham, 1.59, 1.19, and 2.25 respectively; boiled, roast, and fried shoulder, 1.30, 1.73, and 1.89 respectively; boiled and roast spareribs, 1.95 and 2.27 respectively; boiled, roast, and fried liver, 8.09, 13.22, and 13.83 respectively. Considering the recommended daily allowance of niacin as 15 milligrams, an average serving of loin, ham, shoulder, or spareribs would supply 7.9 to 15.1 percent of the day's allowance, depending on the method of cooking. Boiled, roast, or fried liver, however, would provide 53.9 to 92.2 percent of the day's allowance.

The right hams and shoulders were analyzed fresh and the left ones were cured. After 3½ months, the cured meat was analyzed for the same constituents and in the same way as the fresh meat. Curing destroyed 36.3 to 42.5 percent of the thiamin. Roasting, frying, and boiling caused some further destruction. However, less loss occurred in boiling than in the other methods of cooking. In fact, less loss took place in boiling the cured meats than in boiling the fresh cuts.

An average serving of the cured meats, according to the above analyses, contained the following amounts of thiamin in micrograms: boiled ham, 300; boiled shoulder, 293; roast ham, 323; roast shoulder, 196; fried ham, 388; and fried shoulder, 358. From 13.1 to 25.8 percent of the recommended daily allowance of thiamin can be obtained from cured ham and shoulder when cooked in the various ways.

Curing destroyed 36.7 to 42.7 percent of niacin. The further destruction by cooking was only slight as compared with the cooking

effect on thiamin. Also, the effect of cooking was less marked on the niacin content in cured meat than in comparable fresh cuts.

An average serving of cured ham and shoulder contained the following amounts of niacin in milligrams: boiled ham, 1.37; boiled shoulder, 2.01; roast ham, 2.32; roast shoulder, 1.37; fried ham, 2.07; and fried shoulder 2.03. An average serving of cured ham or shoulder, cooked in various ways, would supply from 9.1 to 15.5 percent of the day's allowance of niacin.

Fresh lean pork loin, ham, shoulder and liver were canned in pint glass jars. Thirty-five grams of fat were added to each jar. No water was added to any of the cuts with the exception of liver, to which was added $\frac{1}{3}$ cup per jar. The canned cuts of lean pork contained 17.9 to 25.8 percent of the thiamin found in the different cuts before canning. A quarter of a pound of the edible portion of these cuts, when canned, would contain the following amounts of thiamin in micrograms: loin, 150; ham, 125; shoulder, 94; and liver, 93. From 6.2 to 10.0 percent of the daily allowance would be supplied from an average serving of these canned cuts.

The canned cuts of lean pork contained 84.4 to 99.6 percent of the amount of niacin found in the raw cuts. A quarter of a pound of the edible portions, when canned, would contain the following amounts of niacin, in milligrams: loin, 2.05; ham, 2.58; shoulder, 2.27; and liver, 12.62. Canned loin, ham, or shoulder would supply 13.7 to 17.2 percent, and canned liver 84.1 percent, of the recommended daily allowance of niacin, if 15 milligrams is considered as the daily allowance.

Public service laboratories.—This year, 33,028 specimens were examined, of which 29,826 were examined in the bacteriological laboratory, 2,984 by the food chemist, and 218 by the drug chemist. Of 6,002 throat and nasal swabs cultured for diphtheria and hemolytic streptococci, 124 were positive for *B. diphtheriae* and 439 positive for hemolytic streptococci, the causative agent of scarlet fever and septic sore throat. Microscopical examinations were made on 6,960 specimens for gonorrhea, of which 2,420 were positive; 1,507 specimens of sputum for tuberculosis, 406 positive; 1,920 specimens for intestinal parasites, 234 positive for hookworm, 500 for *Ascaris* or round worm, and 274 for other types of intestinal parasites.

A total of 275 animal heads were received for examination for rabies, of which 261 were satisfactory for examination and 157 (60.1 percent) were positive. This is a slight decrease from last year in the percent of positive heads, and a decrease of 48 percent in the number received for examination, owing largely to the effectiveness of quar-

antine in several counties against dogs running at large. A total of 3,876 stool and urine specimens were examined for typhoid, paratyphoid, dysentery, and *Salmonella* organisms. *Eberthella typhosa* was isolated from 154 specimens of feces and 27 urines. Paratyphoid (Flexner) was isolated from 3 feces, and 5 species of *Salmonella* were found in 7 feces and 1 urine sample. Of the 192 positive feces and urine specimens, 136 were submitted by the Mercer County Health Department during and following an epidemic of typhoid in that county.

Bacteriological examinations were made on 5,857 water samples as compared with 3,988 for last year. Samples from rural supplies, wells, springs, ponds, cisterns, reservoirs, and so on, continue to show a high percentage of fecal contamination. Samples from supervised and treated city supplies showed a satisfactory degree of purity. Chemical analyses were made of 107 samples of water, of which 19 were submitted by city and county health departments, 15 by the Department of Game and Fish, for stream pollution, 23 by the Division of Sanitary Engineering of the State Department of Health, for sewage and industrial waste pollution, and 50 were for chemical analysis for composition, submitted chiefly by private citizens. Nine samples of alcoholic beverages were submitted by State and County law enforcement officials for alcohol determination.

A total of 2,761 samples of dairy products, consisting of 2,710 milks, 30 creams, 9 ice creams, 5 buttermilks, and 7 chocolate milks were examined bacteriologically for sanitary condition. Chemical analysis was made of 2,768 samples of milk, of which 105 contained 4 to 39 percent added water, and 69 were below legal standard for butterfat. Chemical analysis was also made on 35 samples of cream, 76 ice creams, 10 chocolate milks, and 6 buttermilks. The Division of Foods, Drugs and Hotels submitted 167 official samples of food products, comprising 66 ice creams of which 41 were deficient in butterfat, total milk solids or both. Twenty-five samples of butter were examined for filth, mold count, fat, and moisture content, and 15 (or 60 percent) were found to be adulterated in one or more respects. Among other food products examined were hamburgers, frankfurters, sausage, cornmeal, and carbonated beverages.

A total of 98 special investigations were made, of which 48 were in connection with cases of bacterial food poisoning, and 50 for chemical analysis for presence of added poison. Investigations included samples of candy, lettuce, sandwich meat, hamburgers, liver, cheese, crushed pineapple, pork sausage, cake, canned spinach, cooked oatmeal, salad dressing, orange ice, granulated sugar and other foods.

Analysis of 291 authentic samples of milk produced in the Experiment Station Dairy, were made to determine seasonal variation, if any, in freezing point, pH, acidity, butterfat, and solids-not-fat.

A total of 22,400 sterile specimen containers were assembled and shipped out to County Health Departments for use in submitting specimens for examination.

Nursery inspection.—Supplies of fruit trees will continue to be short of demand during 1944-45. This condition is the result of several factors, chief of which is the scarcity of skilled labor in the areas producing understocks for budding and grafting. It is possible, with sufficient labor, to produce within one favorable growing season enough one-year-old apple whips and June-budded peaches to relieve the acute shortage in these two items. Little improvement in the supply of pears and cherries, however, can be expected in less than three years.

The nursery inspector made 77 regular inspections, including 978 acres of nursery plants, 11,300 square feet of sweetpotato plant beds and 700,000 square feet of greenhouse plants. In the order of frequency of occurrence, the following insects and plant diseases were found during inspections: *Insects*—bagworm, red spider, elm leaf beetle, oriental fruit moth, holly leaf miner, euonymus scale, pine shoot moth, white pine bark aphid, strawberry crown borer, iris borer, maple vein gall, wooly aphid. *Diseases*—cedar rust, phloem necrosis (elm), iris leafspot, fireblight, peony blotch, iris rot, canker of pussy willow, canker of weeping willow, gladiolus scab.

Phloem necrosis, a disease of elms, is taking a heavy toll of these trees throughout Kentucky and surrounding states. Nurserymen are discouraging the use of elms in landscape and highway plantings because of this disease for which there appears to be no satisfactory remedy. All trees affected with phloem necrosis found within a nursery planting are destroyed.

Bermuda grass is becoming a pest in nurseries growing ornamental material. The practice of moving evergreens, shrubs and shade trees with balls of earth spreads the Bermuda grass by means of the underground stolons within the balls of earth. It seems that such balled material brought into Kentucky from states to the south has been the primary source of infestation.

Seed inspection.—During the year ending December 1, 1944, the seed analysts tested 5,596 samples of seed. Of this number 481 were official (or collectors') samples, 1,013 were tobacco samples and the remainder, or 4,102 were miscellaneous samples. Purity tests were made on 3,215 samples and germination tests on 5,535. Samples re-

ceived are classified as follows: grasses, 1,064; legumes, 1,655; cereals, 1,011; large-seeded legumes, 217; hemp, 48; vegetables, 91; miscellaneous, 16; official, 481; and tobacco, 1,013.

Tobacco seed cleaned during the year amounted to 2,255.5 pounds representing 680 lots. Germination tests were made on 1,112 samples of tobacco seed.

As a part of the federal hemp program, the Kentucky Station tested for the Commodity Credit Association 10,644 samples of hemp seed for purity and germination.

Creamery license section.—Licenses to buy milk or cream on butterfat basis issued and in force totaled 1,003, of which 983 were renewals and 20 were issued to establishments beginning operation after July 1. The total included 8 creameries, 16 cheese plants, 7 condenseries, 73 milk plants and ice cream manufacturers, 30 independent operators of cream stations, and 869 cream stations under contract to creameries. Authority to test for the period ending June 30, 1945, was issued to 1,103 operators using the Babcock test. These included 817 renewal licenses, 109 licenses issued since July 1 after satisfactory examination, and 77 permits pending examination issued since July 1.

Examinations for applicants for license to test were held as follows: Bowling Green, 4; Lexington, 4; Louisville, 4; Mayfield, 4; Maysville, 2; Owensboro, 3; Princeton, 3; Somerset, 3; Walton, 2; Columbia, 3; special, 3. Of 472 applicants notified to appear for examination, 260 appeared, 239 passed, and 21 failed. Of those failed, 5 reappeared and passed on the second examination.

During the year 809 inspections, including 18,310 tests, were made. Creamery operators were graded as follows: A and B (satisfactory), 388 operators; C (unsatisfactory), 232; D (probation), 172; and E (cited to appear before the Examining Board), 17.

Of 25,159 milk and cream test bottles, cream test weights, and milk pipettes received for calibration, 77 were rejected. Items of buying equipment in use, found on inspection to be incorrect or defective and therefore the cause of inaccurate weights or tests, were: 1 test scale, 52 cream test weights, 16 receiving scales, 17 platform scale weights, 5 centrifuges, 1 divider, 14 thermometers, 30 pieces illegal glassware, and 15 miscellaneous pieces of equipment. These were condemned and ordered to be replaced.

The Examining Board decided 30 cases as follows: 3 revoked licenses were reinstated, 2 inactive testers on probation were dropped from the minutes, 5 testers were removed from probation on satisfactory inspections, 4 were continued on probation with a decision to

be based on future inspections, and 17 licenses, 1 of which had been reinstated earlier in the year, were revoked because of unsatisfactory testing and violation of regulations.

Receipts for the year were \$9,293.96; and expenditures \$10,917.21 as itemized:

Salaries and labor	\$7,937.61
Communication service	276.53
Freight and express	15.94
Sundry and laboratory supplies	7.30
Travel	2,622.89
Miscellaneous	56.94

Feed control.— During 1944, 975 inspectors' and dealers' samples of feed were analyzed and, in addition, determinations were made on a large number of miscellaneous and investigational samples submitted to the Department for various purposes. An unusually large number of samples was submitted by feeders throughout the state, that were suspected of containing some material poisonous to poultry and stock. No added poisons were found in any of these samples. Generally, the cause of complaint of this nature was traced to faulty management.

A report was presented before the A.O.A.C. on the investigation of fat in cooked animal feeds containing cereals. The Department has continued to collaborate with the Association of American Feed Control Officials in its investigational work, about 75 state and commercial chemists participating.

Considerable attention has been given this year to the amount of fluorine in phosphorus-carrying materials used to supplement the phosphorus content of feeds. Some of these supplements contained more fluorine than the animal tolerance would permit.

Fertilizer control.— During the year 681 inspector samples and 31 farmers' and special samples were analyzed. About 500 determinations were made in investigational work. This laboratory continued collaboration with about 70 control and commercial laboratories in the analysis of a monthly check fertilizer sample.

Considerable work was done on the determination of phosphorus in fertilizer mixtures containing organic material. Investigation was continued on methods for acid- and base-forming quality of fertilizers and a report on this work was presented to the Association of Official Agricultural Chemists at the Annual Meeting.

Analyses of limestone, marl, soil, and miscellaneous articles.— Some 480 samples of limestone, 98 of marl and 25 of basic slag were tested for neutralizing value, and 284 samples of soil were analyzed for pH, acidity, nitrogen, total and available phosphorus and available

potassium, for farmers and county agents. Many samples of various kinds, including 20 of water, were examined for individuals in different parts of the state, and nicotine was determined in 60 samples of tobacco leaves sent from the substation at Princeton.

WESTERN KENTUCKY SUBSTATION

General farming.—Farm production was very good this year, despite drouth from June to mid-August. New seedings of clovers and grasses suffered severely and corn and hay yields were greatly reduced. An excellent wheat crop was harvested, and about 1,000 bales of wheat straw were saved. Enough hay was harvested to supply all livestock for another year and both silos were filled with corn silage. About 10 acres were seeded to alfalfa, orchard grass, and bluegrass on August 24, and excellent stands were obtained.

Dairy herd.—The dairy herd averaged 17 milk cows and about an equal number of heifers and calves during the year. Average production per cow from December 1, 1943, to December 1, 1944, was 7,518 pounds of milk and 400 pounds of butterfat. Income above feed cost for the herd totaled \$2,347.35, not including money received as dairy feed payment subsidy. In July the 17 cows in the herd were classified according to the standards of the American Jersey Cattle Club: 2, Very Good; 10, Good Plus; 4, Good; 1, Fair.

Hybrid corn yields.—Eleven white corn hybrids were grown in comparison with open-pollinated Boone County White, and 11 yellow corn hybrids in comparison with open-pollinated Reid's Yellow Dent. Each was replicated 5 times in plots of 30 hills each. Late spring and summer drouth diminished yield considerably. Acre-yields (averages of the 5 replications) of the white hybrids ranged from 50.0 to 56.9 bushels, and of the yellow hybrids from 48.3 to 54.1 bushels. Boone County White averaged 42.8 bushels and Reid's Yellow Dent averaged 46.4 bushels. Rankings of the various hybrids in 1944 (and in 1943 also, for the hybrids included that year) were as follows:

<i>White Hybrids</i>		1943	1944	<i>Yellow Hybrids</i>		1943	1944
Ky 212	7	1	Ky 123	5	1		
Kan. 2234	..	2	Ohio 3089	..	2		
Ky 207	8	3	Kan. 1583	..	3		
Ky 203	4	4	Ky 116	..	4		
Ky 223	..	5	Ky 102	4	5		
Ky 208	..	6	Ky 122	..	6		
Ky 72B	10	7	Ky 103	6	7		
Ky 205	2	8	U. S. 13	7	8		
Ky 228	1	9	Ky 121	..	9		
Ky 226	5	10	Ky 120	3	10		
Ky 232	..	11	Kan. 1585	..	11		

Vegetable versus animal protein for growing pullets.—In the first year of this experiment 2 broods each of Barred Plymouth Rocks and New Hampshires were raised, and two methods of feeding were compared. The chicks were allowed pasture when 6 weeks of age, thereafter those in pen 1 were hopper-fed yellow corn, wheat, and meat scrap with 2 percent of salt added; and those in pen 2 were hopper-fed yellow corn, wheat, soybean oilmeal with 2 percent of salt added, and steamed bonemeal. At maturity the pullets were housed in separate laying pens and fed a laying mash, grain, ground limestone, liquid skimmilk, and legume hay. The first year's results are as follows:

<i>Growing Ration</i>	<i>Average Egg Production per hen</i>		<i>Hatchability, percent</i>	
	<i>Barred Rocks</i>	<i>New Hampshires</i>	<i>Barred Rocks</i>	<i>New Hampshires</i>
Meat scrap, grain, and pasture	185	182	73	79
Soybean oilmeal, bonemeal, grain and pasture	197	200	77	82

There was no significant difference in weight of the pullets either at 12 or 22 weeks of age. There was also no significant difference in average weight of the eggs produced.

Ky 102 yellow hybrid corn versus Reid's Yellow Dent for fattening steers in drylot.—Two comparable lots of 15 good to choice western Hereford feeder steers each were fed for 106 days in drylot. Average daily consumption per steer in lot 1 was 13.97 pounds of Reid's Yellow Dent shelled corn, 0.93 pound of soybean oilmeal, 14.58 pounds of corn silage, and 4.00 pounds of alfalfa hay. Lot 2 consumed exactly the same ration except that the corn was Ky 102 yellow hybrid, instead of Reid's Yellow Dent. The steers in lot 1 gained 2.27 pounds per head per day, dressed 60.8 percent, and produced 4 "U.S. Choice" and 11 "U.S. Good" carcasses. The steers in lot 2 gained 2.24 pounds per head per day, dressed 60.5 percent, and produced 7 "U.S. Choice" and 8 "U.S. Good" carcasses. The average selling price on foot for both lots was \$15.18 per 100 pounds, indicating that there was little difference in the outward appearance of the steers at the end of the test. Though the carcasses differed only slightly, those of the steers fed hybrid corn had slightly thicker, smoother coverings of fat and somewhat more marbling of lean. A similar difference was noted in this experiment last year. The Reid's Yellow Dent corn this year tested 91.0 percent dry matter, 15.6 percent crude protein, 4.1 percent ether extract and 4,089 calories per gram. The Ky 102 hybrid corn this year tested 91.0 percent dry

matter, 11.9 percent crude protein, 5.3 percent ether extract, and 4,176 calories per gram.

Pasture experiments.—Grazing began April 15 on all pastures and continued 166 days. Total rainfall during the grazing season was about 68 percent of normal. Vegetation on the three fields was essentially the same as in recent years but sod on field 2 appeared to have become heavier and that on field 3 less vigorous than a year before.

Steers on the untreated field gained in weight during the season at the rate of 45.9 pounds per acre. On field 2, which has received ground rock phosphate at rates averaging about 180 pounds per acre per year, the steers gained 158.6 pounds per acre. Steers on field 3, which has received an average of about 100 pounds of superphosphate per acre per year and 2½ tons of limestone in 16 years, gained 148.7 pounds per acre.

Grasses.—In this third year of a comparative test of grasses harvested twice during the year as hay, Kentucky 31 meadow fescue produced 1,070 pounds per acre; southern smooth brome grass, 885 pounds; orchard grass, 652 pounds; redtop, 618 pounds; and Kentucky bluegrass, 468 pounds. The plots of timothy and ordinary meadow fescue died in the latter part of 1943. Drouth throughout much of the summer accounts for the low yields this year.

Ammonium nitrate top-dressings on wheat.—In a test of time (spring or fall) and rate (20 or 40 pounds of nitrogen) of applying ammonium nitrate as a top-dressing for wheat, the highest yield of grain (15.6 bushels per acre more than the check, 25.3) was obtained on the plot which received 20 pounds of nitrogen in the fall and the same amount in the spring, though 20 or 40 pounds in spring only were almost as effective, 11.6 and 13.5 bushels per acre, respectively, more than the checks. Results were in line with a similar test at the Experiment Station farm at Lexington (page 13).

Peach varieties.—A relatively mild winter that caused virtually no dormant-bud killing was followed by a series of sharp freezes and frosts between mid-March and early May, a severe test of hardiness between prepink-bud and shuck-fall stages. Variety performance (fruit set and matured) was as follows:

Full crop: Veteran, South Haven, Viceroy, and Dr. Burton.

Three-fourths crop: June Elberta, Sunbeam, Oriole, Vedette, Halchaven, U. S. V. 9-60, and Colora.

One-half crop: July Heath (Othelle), Fair's Beauty, Marigold, U. S. V. 1-72, and U. S. V. 9-93.

One-fourth crop: Early Rose, Ideal, Georgia Belle, Early Red Free, Mamie Ross, Alton, Golden Beauty, Rio Oso Gem, Afterglow, Ambergem, Missouri 50, South Haven No. 20, and Triogem.

An occasional peach: Golden Jubilee, Cumberland, Fireglow, Sunhigh, Fisher, Gage Elberta, Slappy, Barbara, Redelberta, Champion, and Tena.

No crop: Gold Aflame, Dixiegold, Early Hiley, Hiley, Raritan Rose, Golden East, Golden Globe, Summercrest, White Hale, Short, Frank, Polly, Sun Gold, Niles Elberta and Garden State Nectarine. —

These records indicate the spring hardiness of Veteran and Viceroi, two winter-hardy varieties that are at least very promising for home orchard plantings and local sales. Also, Halehaven, a promising early commercial variety, further proved its dependability; and U.S. V. 9-93 and Fair's Beauty, of the Golden Jubilee season, showed more resistance than the latter, a favorite of its season.

Plum varieties.—In spite of severe frosts and freezes from the delayed dormant stage to the petal-fall stage, Bruce, Munson, and American plums set and produced good crops of fruit. These three varieties have borne heavy annual crops since 1940. Gold variety produced no fruit; Compass, a late-blooming sort, survived the freezes but lost most of its blossoms to brown-rot blossom blight. Early Italian Prune, Italian Prune, Shropshire, French and Blue Damson, all late bloomers, had only a very light bloom and lighter set of fruit that matured into only an occasional fruit. No curculio or brown rot was found in any mature plum fruits.

Strawberry varieties.—In the main variety test the yields in crates per acre were: Blakemore, 175; Tennessee 393, 111; Tennessee Shipper, 96; Tennessee Beauty, 93; Aroma, 63. Tennessee Shipper and Tennessee Beauty are showing considerable adaptability and promise for commercial production in Western Kentucky. A sharp freeze on May 7, one week before Blakemore harvest started and while late varieties were still in full bloom, seriously reduced the yields, especially those of Tennessee Shipper, Tennessee Beauty, and Aroma. Ten new selections by the U. S. Department of Agriculture were fruited for the first time in 1944. Some of these showed promise for commercial and home use. In all, 24 varieties and selections were fruited in 1944.

Blackberries and dewberries.—Eldorado, Early Harvest, Ozark Beauty and Alfred, upright sorts, produced a heavy crop of berries but the yield and size of berries was seriously cut by the drouth. Brainerd, a semi-trailing type, suffered some winter cane injury and bore only a light crop. These berries, however, did not suffer from the dry weather as did other varieties. Young and Boysen, purple-fruited trailing sorts of dewberry type, suffered severe winter cane killing, even though mulched, and bore only an occasional berry. Experience in this planting, made in 1939, has shown Boysen and Young

to be too tender for this climate, and Brainerd and Ozark Beauty to be only semihardy and subject to serious winter-killing. Alfred and Eldorado are hardy and bear large, fine fruit, of which that of Alfred is larger and of better quality. Early Harvest is hardy and very productive but is handicapped by small fruit. Alfred's serious fault is in its low resistance to orange rust. Eldorado and Early Harvest also suffered from this disease, the other varieties not at all.

Boron deficiency trials with apples.—Serious internal corky spots in the fruit and dropping were prevalent on previously affected yellow transparent trees not fertilized with borax, whereas no internal cork and only very little dropping resulted on trees that were treated with borax in 1943. Cork in the fruit and dropping of fruit also occurred on nearly all Winesap and Anoka trees in 1944 for the first time. *Apple rust*

Quince rust control.—For several years quince rust, a close relative of cedar apple-rust, has caused serious loss of fruit in the Western Substation apple orchard. Trees sprayed this year with a mixture of $\frac{1}{2}$ pound of fermate and 3 pounds wettable sulfur per 100 gallons, yielded an average of 5 bushels per tree in the Stayman variety, 2 bushels in Delicious, and 1 bushel in the Winesap variety, more than trees sprayed with the same number of straight sulfur sprays (6 lb per 100). Counts of dropped fruits were kept on 12 trees of each variety from June to harvest. Only 7 percent of the drops on fermate-sprayed trees were infected with quince rust, while 53 percent of the drops of regular sulfur-sprayed trees were infected.

Apple varieties and cover crops.—In this planting made in 1926 the cultivated plot with soybeans, rye, and vetch as cover crops has continued to lose out since 1940, as compared with the adjoining plots having lespedeza sod and lespedeza sod plus mulch. In 1944 both of the sod plots yielded an average of 2 bushels more per tree, of larger, higher-quality fruit, than the cultivated cover-crop plot. The sod plots also made about double the trunk circumference growth, longer and heavier shoot growth, and heavier, more luxuriant foliage. As to variety yields, Stayman led in average total yield with 11.4 bushels per tree, and Winesap was second with 10.8 bushels. Then came Delicious with 7.5 bushels, and Yellow Transparent with 3.9 bushels.

ROBINSON SUBSTATION

General farming.—Continued drouth in the summer failed to reduce the yield of field crops in this section as much as in other sec-

tions of the state. The corn crop was good and enough corn was produced to supply the estimated needs for the year.

Hay was harvested from 2 acres of Korean lespedeza, 6 acres of alfalfa, 3 acres soybeans, and the various agronomy plots, totaling some 60 tons of hay.

Fruits.—The apple crop this year was the best produced since the orchard began to bear fruit some 8 years ago. The crop amounted to 800 bushels, all good, clean fruit which sold for \$1 to \$3 per bushel at the orchard. Five bordeaux sprays were used instead of 3 in previous years, and the mixture was stronger (8-8-100 instead of 4-6-100). As a result, bitter rot was well controlled.

Last year 1 of 4 pecan trees set 10 years ago produced 2 pounds of nuts. This year this tree produced 10 pounds of nuts and the other 3 produced 1 to 2 pounds per tree. It is evident from this small project that pecan trees will grow and produce nuts in this section of the state.

Livestock and poultry.—In the project of breeding up scrub cattle by use of a purebred Brown Swiss bull, there were in the herd at the end of the year (the third year of this project) the following increase: 1 purebred Brown Swiss heifer calf, 2 purebred Brown Swiss bull calves, 2 Swiss-and-scrub grade heifer calves, and 1 Swiss-and-Jersey grade heifer calf. Four pure-bred Brown Swiss bull calves have been sold for breeding purposes, three of them remaining in this county. The herd at this time consists of 1 bull, 14 cows, and 10 heifers and calves.

Duroc Jersey and Hampshire are the two breeds of hogs used at the Substation, and these are the breeds recommended for this section of the mountains.

Plymouth Rock and Rhode Island Red chickens are used at the Substation. Twelve hundred baby chicks were hatched at the Lexington Station, from eggs produced here, and were raised at the Substation. From the chicks raised 200 were selected, banded, and placed in the laying houses in October.

Simplified methods of feeding growing pullets.—This experiment at the Robinson Substation included a comparison of mash and grain versus cafeteria feeding during the growing period. Both broods were fed a well-balanced mash for four weeks. One brood was then given grain and mash; the other was fed a cafeteria type feed in hoppers. This feed consisted of yellow corn with one percent cod-liver oil added, meat scrap with 2 percent of salt added, soybean oilmeal and lespedeza hay fed in racks. When the pullets were old enough

they were allowed to range on green pasture; and when mature they were transferred to laying houses and fed grain and laying mash during the laying year. The results are as follows:

	Average Production	
	Barred Rocks	Rhode Island Reds
Mash and grain	162	204
Cafeteria fed	183	217

Production was greater than in previous years when the pullets were continued on the same feed as that fed during the growing period.

Sorghum sirup.—Because rainfall from May to August 15 was almost 7 inches below normal, and was above normal thereafter, the growing season was distinctly unfavorable for sorghum. Untreated plots in the fertilizer test produced 24 ten-pound pails of 80 percent sirup per acre. The plot treated with limestone and the equivalent of 650 pounds per acre of 5-10-5 commercial fertilizer produced the highest yield, 67.5 pails of sirup; and the plot treated with the same amount of complete fertilizer alone produced 32.5 pails. It is likely that the beneficial effect of liming upon sirup yield is indirect, inasmuch as the limed plot produced better legumes and grass in the rotation than the unlimed plot. This effect was relatively greater this year than in recent years of more nearly normal rainfall when yields were $2\frac{1}{2}$ to 3 times larger than this year.

The sorghum variety test included 12 varieties. Yields ranged from 61 to 80 ten-pound pails of 80 percent sirup per acre. The highest yield was produced by a variety that in previous years produced only intermediate yields. The Williams variety, which usually produces the highest yield, produced 61 pails of sirup per acre this year. As usual, however, sirup made from the Williams variety was superior to that made from other varieties.

Relative sirup yields obtained this year from the varieties apparently were determined largely by different response to rains after mid-August. Some varieties matured more rapidly and earlier than normal. Others became vegetative and matured later than normal.

Mine props from Robinson forest.—Production of mine props for sale in the Hazard coal fields was undertaken this year. Cutting was confined to areas which would probably not be entered for sawlogs for a long time, and the work was planned to improve the forest by removing defective trees and inferior species. Both cutting and hauling were done on a price per piece basis. Notwithstanding the difficulty in getting laborers and truckers, the work paid for itself, leaving the benefit to the forests as a clear gain. Destruction of resi-

dual trees in this type of logging is negligible and the debris left is of minor consequence.

NEW PROJECTS — 1944

Dried wheat distillers' solubles as a protein supplement for growing-fattening hogs in drylot.

The value of different methods of feeding wheat distillery slop to hogs.

Place and grade differentials in hog prices.

The marketing, distributing and pricing of feed for Kentucky livestock.

Dried wheat distillers' solubles vs soybean oilmeal as a protein supplement for cattle fattened in drylot.

The relative efficiency of three grades of steers for slop feeding purposes.

The relative palatability of monocalcium phosphate, dicalcium phosphate, fused rock phosphate and steamed bonemeal for dairy cattle.

The value of dried wheat distillers' solubles as a protein supplement for dairy cows.

Nicotine and other products from green tobacco.

Phosphorus fixation and release by Kentucky soils.

PUBLICATIONS

BULLETINS

455. Fused rock phosphate for chicks. E. S. McConnell, W. M. Insko, Jr., and G. Davis Buckner. March, 1944.
456. Effects of war on farm population in Kentucky. Howard W. Beers. April, 1944.
457. Effect of fall application of nitrogen fertilizer on the soluble nitrogen and phosphate phosphorus content of dormant peach twigs. C. S. Waltman. April, 1944.
458. Marketing turkeys in Kentucky. John B. Roberts. April, 1944.
459. Prices and market data on lambs, hogs, and veal calves at four central Kentucky livestock auction markets, 1926-1943. April, 1944.
460. Seasonal price movements of fire-cured tobacco in Kentucky. Carl M. Clark, Wendell C. Binkley and David M. Pettus. April, 1944.
461. Agriculture of the Kentucky Pennyroyal Plain. David L. MacFarlane, Ernest J. Nesius, Charles R. Sayre, and Robert E. Graham. May, 1944.
462. A genetic analysis of recent Thoroughbreds, Standardbreds, and American Saddle Horses. Dewey G. Steele. May, 1944.
463. Farm management handbook. Based on studies of Pennyroyal farms. Ernest J. Nesius, Charles R. Sayre, David L. MacFarlane, and Robert E. Graham. June, 1944.
464. Land tenure in southern Logan County, Kentucky. John H. Bondurant. June, 1944.

465. Age structure of Kentucky population, 1940. Howard W. Beers and Robin M. Williams. June, 1944.
466. Life history of the wireworm *Conoderus auritus* (Herbst). H. H. Jewett. June, 1944.
467. Dynastinae of North America with descriptions of the larvae and keys to genera and species (Coleoptera: Scarabaeidae). P. O. Ritcher. September, 1944.
468. Control of the strawberry crown borer by methyl bromide fumigation and with poison baits. P. O. Ritcher. November, 1944.
469. Fertility rates and migration of Kentucky population, 1920 to 1940, as related to communication, income, and education. Merton D. Oyler. November, 1944.
470. Nicotine content of *Nicotiana Rustica* grown in Kentucky and of 15 selections of dark tobacco. C. W. Woodmansee, Karl E. Rapp, and J. S. McHargue. November, 1944.

REGULATORY SERIES BULLETINS

38. Commercial fertilizers in Kentucky in 1943. J. D. Turner, H. R. Allen, and Lelah V. Gault. September, 1944.
39. Commercial feeds in Kentucky in 1943. J. D. Turner, Stacy B. Randle, W. G. Terrell, and J. J. Rose. September, 1944.
40. Seed inspection in Kentucky, 1943-44. W. A. Price, Mary L. Didlake, E. C. Vaughn, Encil Deen, Howard Tilson, Alice McDaniel, Katharine Fried, Margaret Morton, Mary Lee Littell, and Lucy Baugh. September, 1944.
41. Some plant and insect problems of Kentucky nurserymen during the year ended June 30, 1944. W. A. Price and Howard G. Tilson. September, 1944.

EXPERIMENT STATION CIRCULARS

55. Some parasitic diseases of sheep. Prevention and Control. W. W. Dimock. July, 1944.
56. Diseases of sheep. F. E. Hull and E. R. Doll. November, 1944.

ANNUAL REPORT

Fifty-sixth annual report of the Experiment Station (for 1943). Thomas P. Cooper.

MISCELLANEOUS

Kentucky Fruit Notes, issued quarterly (January, May, August, and November). W. D. Armstrong, editor.

SCIENTIFIC PAPERS

In Agronomy

- Breeding tobacco for resistance to mosaic. W. D. Valleau. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- Can tobacco blue mold fungus be eradicated? W. D. Valleau. *Phytopathology* 34:1012. 1944. Abstract.
- Determining chlorophyll, carotene, and xanthophyll in plants. R. B. Griffith and R. N. Jeffrey. *Indus. and Engin. Chem. Analyt. Ed.* 16:138-40. 1944.
- Effect of particle size of phosphate fertilizers on availability of their phosphate to plants. G. L. Terman. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- Erosion control on slopes steeper than twelve percent. Earl G. Welch. *Agr. Engin.* 25 (4):123, April, 1944.
- Growth and overwintering of *Xanthomonas vesicatoria* in association with wheat roots. Stephen Diachun and W. D. Valleau. *Phytopathology* 34:998-999. 1944. Abstract.
- Growth of some animal pathogens on wheat roots. Stephen Diachun and W. D. Valleau. *Jour. Bact.* 48:122. 1944. Abstract.

- Invasion of water-soaked tobacco leaves by bacteria, solutions, and tobacco-mosaic virus. Stephen Diachun, W. D. Valleau, and E. M. Johnson. *Phytopathology* 34:250-253, February, 1944.
- Mechanical erosion control on cultivated land steeper than recommended terrace-able slopes. Earl G. Welch. *Agr. Engin.* 25:123-124. April, 1944.
- The plant bugs *Miris dolabratus* L. and *Amblytylus nasutus* Kirschbaum, and their injury to Kentucky bluegrass, *Poa pratensis* Linn. H. H. Jewett and J. T. Spencer. *Amer. Soc. Agron. Jour.* 36:147-151. February, 1944.
- The problem of securing machinery for farm reservoir construction. J. L. McKittrick. *Agr. Engin.* 25 (12): 460. December, 1944.
- Root infection of crop plants and weeds by tobacco leaf-spot virus. W. D. Valleau, E. M. Johnson, and Stephen Diachun. *Phytopathology* 34:163-174. February, 1944.
- The semimicro determination of magnesium as the quinolate using the colorometric ferric chloride method. M. E. Weeks and J. R. Todd. *Ky. Acad. Sci. Trans.* 10 (3): 33-41. (Appeared in 1944.)
- The uptake of native and applied phosphorus by corn crops grown on Kentucky soils. M. E. Weeks. *Soil Sci. Soc. Amer. Proc.* 8:201-204. 1944.

In Animal Husbandry and Dairying

- Comparative gross energy values of growing and continuously cropped Bluegrass and Korean lespedeza. G. Davis Buckner, W. M. Insko, Jr., and Elizabeth F. Wachs. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- Continuously cropped and continuously grown bluegrass as supplemental feed for laying hens. G. Davis Buckner, W. M. Insko, Jr., Amanda H. Henry, and Elizabeth F. Wachs. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- Distillery slops as feeds for fattening steers. W. H. Black, N. R. Ellis, and W. P. Garrigus. *Jour. Anim. Sci.* 3:435-436, November, 1944.
- Does breed, age, sex or laying condition affect the pH of the digestive system of chickens? G. Davis Buckner, W. M. Insko, Jr., and Amanda H. Henry. *Poultry Sci.* 23:457-458, September, 1944.
- Effects of age on reproductive phenomena in the hen. Dewey G. Steele and W. M. Insko, Jr. *Poultry Sci.* 23:552-553. 1944.
- The effects of several variables on the digestibility of some common pasture forages by steers. W. P. Garrigus. *Jour. Anim. Sci.* 3:449. November, 1944.
- A genetic analysis of recent saddle horses. Dewey G. Steele. *Amer. Horseman-Sportologue* 12:22-23, March, 1944.
- The growth, chemical analyses and feeding values of growing and continuously cropped Korean lespedeza. G. Davis Buckner, Fordyce Ely, Amanda H. Henry, and Elizabeth F. Wachs. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- The identity of udder streptococci in several Kentucky dairy herds. H. B. Morrison and F. E. Hull. Presented at meeting of the Kentucky branch of the Society of American Bacteriologists, Lexington, October 28, 1944. To be published in the *Jour. Bact.*

In Animal Pathology

- The equine thyroid in health and disease. W. W. Dimock, Clifford Westerfield, and E. R. Doll. *Amer. Vet. Med. Assoc. Jour.* 104 (807):313-317, June, 1944.
- Nematode parasitism of sheep. E. R. Doll and F. E. Hull. *Amer. Vet. Med. Assoc. Jour.* 105 (808):13-21, July, 1944.
- A new *Salmonella* type isolated from man and fowls. P. R. Edwards and Hope Hughes. *Jour. Bact.* 47:574. 1944.
- A new *Salmonella* type with hitherto undescribed somatic antigens. P. R. Edwards and Hope Hughes. *Soc. Expt. Biol. and Med. Proc.* 56:33, May, 1944.
- Salmonella loma-linda*: A new type isolated from meningitis. P. R. Edwards. *Soc. Expt. Biol. and Med. Proc.*, 57:104. 1944.

In Chemistry

- Effect of boron concentration in the nutrient solution on the soluble and insoluble nitrogen fractions of spinach. P. N. Scripture and J. S. McHargue. Amer. Soc. Agron. Jour. 36 (10):865-869, October, 1944.
- Effect of manganese intake upon concentration of bisulfite-binding substances in blood. J. T. Skinner and J. S. McHargue. Amer. Jour. Physiol. 141 (5): 647-650, July, 1944.
- Influence of manganese intake upon urea excretion. J. T. Skinner and J. S. McHargue. Presented at annual meeting of Ky. Acad. Sci., April 28-29, 1944.
- Some functions of mineral elements in connection with enzymatic action. J. T. Skinner. Presidential address, Kentucky Academy of Science, 30th annual meeting, Louisville, Ky., April 23-24, 1943. Ky. Acad. Sci. Trans. 11 (1): 5-12, June, 1943. (Appeared in 1944.)

In Entomology and Botany

- Control of curculio in Kentucky. W. D. Armstrong and P. O. Ritcher. Illinois Hort. Soc. Trans. 77:466-472. March, 1944.
- The plant bugs, *Miris dolabratus* L., and *Amblytulus nasutus* Kirschbaum, and their injury to Kentucky bluegrass, *Poa pratensis* Linn. H. H. Jewett and J. T. Spencer. Amer. Soc. Agron. Jour. 36:147-151. February, 1944.

In Farm Economics

- The community school and the world community. Howard W. Beers. Phylon, December, 1944.
- Improving farm tenure in the midwest, Regional Committee bulletin, John H. Bondurant, joint author. Illinois Agricultural Experiment Station Bul. 502:141-169, June, 1944.
- Population factors affecting post-war education in Kentucky. Howard W. Beers. Proc. 20th Ann. Educational Conference; Bulletin of the University of Kentucky Bureau of School Service 16 (2): 81-82, 1944.
- The urban status of rural migrants. Howard W. Beers and Catherine Heflin. Social Forces 23 (1): 32-37. October, 1944.

In Feed and Fertilizer Control

- Factors affecting determination of acid- and base-forming quality of fertilizers. Harry R. Allen and Lelah Gault. Assoc. Off. Agr. Chem. Jour. 27:171-177, February, 1944.
- Report on acid- and base-forming quality of fertilizers. H. R. Allen and Lelah V. Gault. Presented at meeting of Assoc. Off. Agr. Chem., October 25-26, 1944.
- Some checks on methods and solutions used in analysis of fertilizers. H. R. Allen. Presented at meeting of the Amer. Chem. Soc., New York, September 11-15, 1944.

In Horticulture

- Control of curculio in Kentucky. W. D. Armstrong and P. O. Ritcher, Illinois Hort. Soc. Trans. 77:466-472, March, 1944.
- The effect of "split applications" of nitrogen and phosphorus on the yields of tomatoes and large seeded lima beans. E. M. Emmert. Amer. Soc. Hort. Sci. 44:433-440, May, 1944.
- The rapid determination of total nitrogen in soil. E. M. Emmert. Soil Sci. 58 (4):289-290. October, 1944.
- Use of monochloroacetic acid to include ammonia in the soluble nitrogen tissue test. E. M. Emmert. Plant Physiol. 19 (3):562-563.
- The use of phenoldisulfonic acid in estimating potassium in the cobaltinitrite precipitate from potato tissue extracts. E. M. Emmert. Amer. Soc. Hort. Sci. 44:381-383, May, 1944.

FINANCIAL STATEMENT

Receipts and expenditures under Hatch, Adams, Purnell, and Bankhead-Jones Acts,
and the State Offset Required by the Bankhead-Jones Act.

Fiscal year ended June 30, 1944

	Hatch	Adams	Purnell	Bankhead-Jones	Bankhead-Jones Offset
<i>Receipts</i>					
From the Treasurer of the United States as per appropriations for fiscal year ending June 30, 1944	\$15,000.00	\$15,000.00	\$60,000.00	\$81,533.32	
Receipts from sources within the state as Bankhead-Jones offset					\$81,533.32
<i>Expenditures</i>					
Personal Services:					
Administration	3,500.00				
For all other purposes	11,017.56	14,007.84	54,045.07	72,787.89	
Travel	154.62		2,105.35	653.36	
Transportation of Things	2.01	22.60	23.82	144.17	
Communication Service			123.33	677.78	
Rents and Utility Services:					
Rent of space in buildings or equipment			41.80	4.88	
Printing and Binding:					
Printing publications	325.81		580.20	547.42	
Other printing and binding			1,152.50	933.09	
Other Contractual Services:					
Repairs and alterations to equipment, and other contractual services not otherwise classified			215.86	122.50	
Supplies and materials		931.33	1,288.65	4,485.29	
Equipment		38.23	423.42	1,176.94	
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	81,533.32	
Unexpended balances June 30, 1944	.00	.00	.00	.00	
BANKHEAD-JONES OFFSET, TOTAL APPROVED EXPENDITURES					\$81,533.32

We, the undersigned, certify that the receipts and expenditures shown in this report from Federal funds and as offset to Bankhead-Jones funds are correct; that the expenditures were solely for the purposes set forth in the acts of Congress approved March 2, 1887 (Hatch), March 16, 1906 (Adams), February 24, 1925 (Purnell), May 16, 1928 (Hawaii), February 23, 1929 (Alaska), March 4, 1931 (Puerto Rico), June 29, 1935 (Bankhead-Jones Title I), June 20, 1936 (Alaska) and March 4, 1940 (Employer Contributions to Retirement); that the expenditures are in accordance with the terms of said acts so far as applicable to this station; and that properly approved vouchers are on file for all expenditures.

Signed:

THOMAS COOPER

Director of Experiment Station

FRANK D. PETERSON

Comptroller

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